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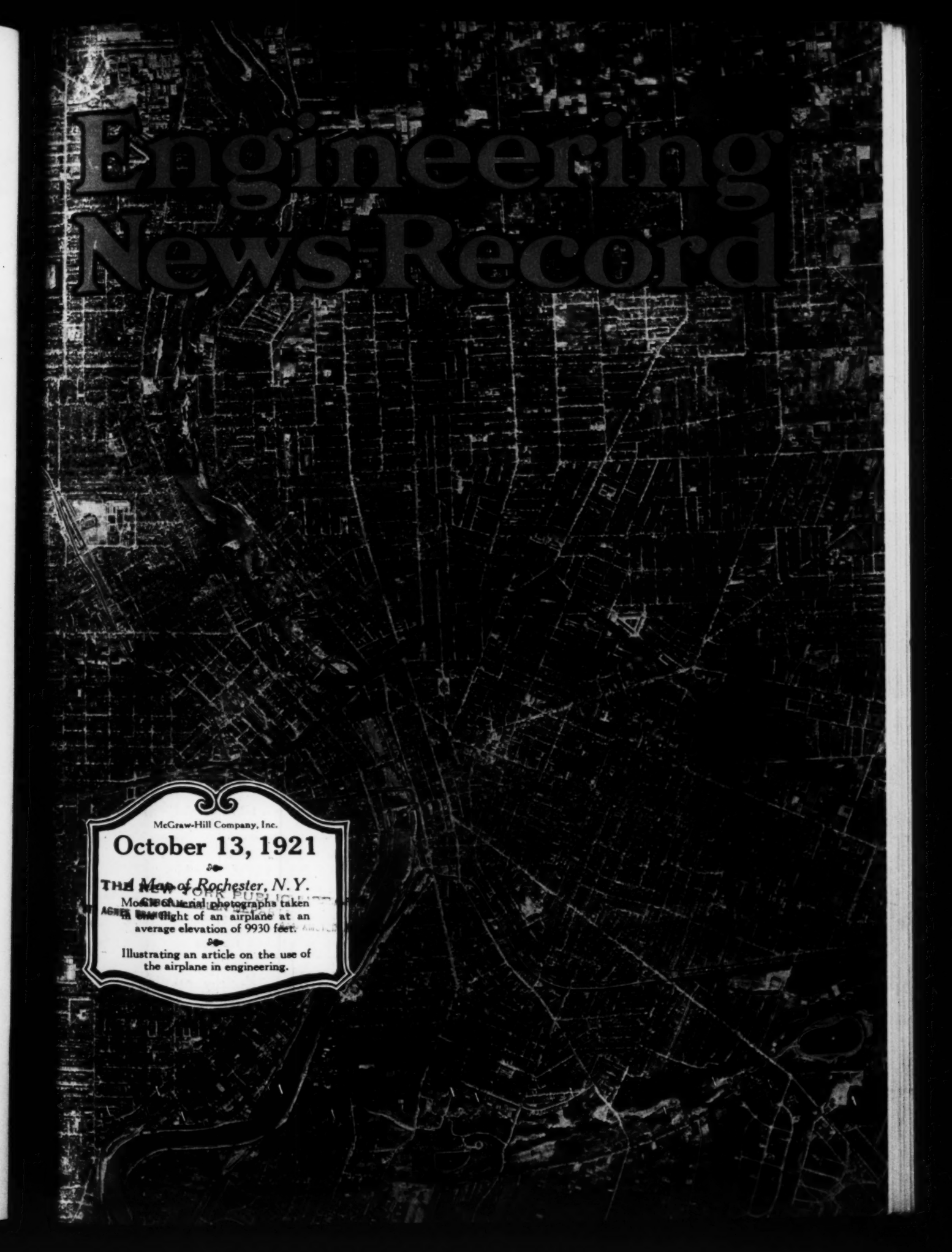

THE MAP of Rochester, N.Y.

Mosaic of aerial photographs taken in flight of an airplane at an average elevation of 9930 feet.

Illustrating an article on the use of the airplane in engineering.

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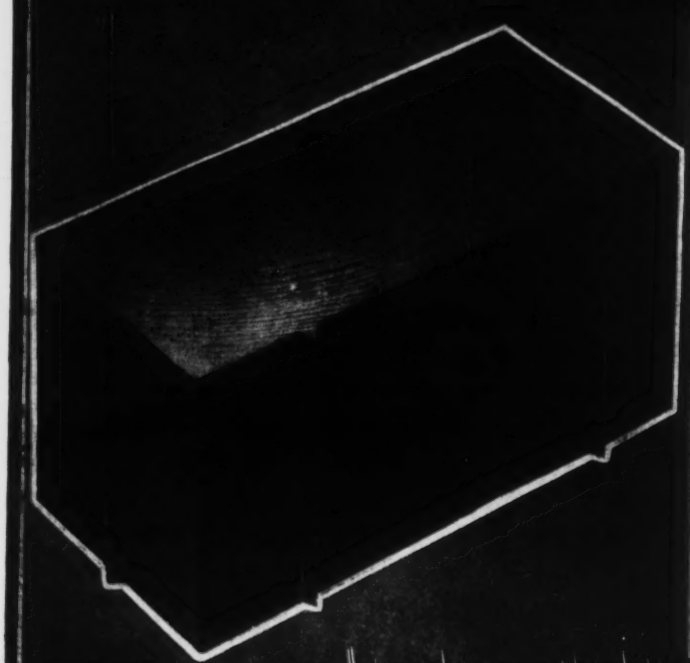

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 87 — NEW YORK, OCTOBER 13, 1921 — Number 15

Why Stop There?

AS A PART of a policy of retrenchment the city council of Swift Current, Sask., has dismissed its city engineer and its chief of police. The reported savings is $12,000 a year. Why should the city council stop there? Why not abolish the whole city government?

Freight on Street Railways

THREE of the most serious problems in city life today are how to relieve street congestion, how to provide a low-cost street railway ride, and how to reduce the cost of product distribution. During the past week two separate proposals have been made to solve, partly at least, all three by one expedient, the transportation of interior freight on street-car or rapid-transit lines. At the American Electric Railway Association meeting at Atlantic City, J. R. Bibbins urged the utilization of all electric railways for freight terminal service, for the transport to and from the city of the goods laid down in or to be delivered to the railway terminal yard. In New York City the Transit Commission proposed to the Port Authority that the express tracks of the subways be used in non-rush hours at night for distribution of freight to outlying terminals. By such utilization the subway revenue would be increased and the local freight distributed at low cost with an appreciable reduction of the motor traffic now involved in such transfer. These are not new suggestions but they are pertinent ones which deserve more consideration now than they have received in the past. There is a big investment in street railways in our cities, which is in danger of being wiped out; if there is a chance that it can be saved by utilizing it to reduce living costs and make traveling about the city by foot or by vehicle more tolerable, the experiment would be worth trying.

Progress on Highway Bill

THOSE state highway departments which have been concerned with the course of Congressional action on the proposed amendments to federal-aid highway legislation will welcome this week's news from Washington indicating that the conferees of the Senate and the House have reached agreement on a measure. The present bill is very similar to the one passed by the Senate; the principal changes are enumerated in this week's news pages. The appropriation has been left at $75,000,000, although many favored a larger sum but feared adverse action by the House in the event of greater demands. In connection with the status of the federal highway bill, it is worth while to note the comment from a number of state highway engineers, appearing in this week's news section, in answer to a query as to policy on the letting of next season's highway contracts this fall. It is clear that many states have either entirely used up or definitely allocated all available funds for road-building purposes and that if their highway construction programs are not to be interrupted additional federal aid must be provided. It is essential that this be done at the earilest date, for there is always a lengthy interval between the authorization of funds by the federal government and their availability for actually paying construction costs in the states. This feature, so well known to state highway engineers, is not generally realized by our legislators, who need not concern themselves with problems of planning the year's work, developing a highway-building organization and maintaining it with the properly qualified personnel. Seasonal slackness or activity, as has been pointed out convincingly in the survey initiated by Secretary of Commerce Hoover and recently carried out by the American Engineering Council, is one of the biggest sources of waste in industry. In the prosecution of our highway building program the full value for the millions spent each year can be secured only under a continuing policy which assures to those charged with the planning and execution of the work a steady and adequate supply of funds.

No Time to Discriminate

IN A RECENT meeting of the New York Building Congress, Hugh Frayne, general representative of the American Federation of Labor for the New York District, urged that in the present crisis preference be given American citizens in finding work for the unemployed. He believes that the worker who has no intention of becoming Americanized should be replaced, if employed, and deported to his native country if unemployed. This is a drastic recommendation. With the general principle of trying to induce those who come to our shores to enter heartily into the spirit of America, to cast their lot here permanently, to adopt our standards of living and our ideals, we are in hearty accord. But having allowed these people to come here, we have contracted an obligation of protecting them from discrimination. Mr. Frayne's recommendation is, to our mind, thoroughly un-American, though we are sure that in making his proposal he is entirely unconscious of the injustice he contemplates. Now is not the time for discrimination. Rather, by giving every honest worker a helping hand we shall aid in that Americanization of which Mr. Frayne is so strenuous an advocate.

The Revival of Business

OBSERVERS in every field speak hopefully of the outlook. Optimism reigned last week at the convention of the American Bankers Association. The textile and shoe industries are working at nearly full capacity; the steel industry is picking up. Retail stores are reporting good business, and newspaper advertising is on the increase. The railroads are getting into better position. Carloadings are increasing weekly, and, even though maintenance and repair forces have been increased on some roads, there is, in general, a steady

improvement in net earnings. All of these factors contribute to the growing feeling of confidence, and well established confidence is a sure forerunner of healthy business conditions. Only export trade seems to lag badly, but that is caused by the very unsatisfactory position of the foreign exchanges and the consequent inability of Europe to buy in large volume. While the outlook is encouraging, there is nevertheless a feeling that we cannot count upon a boom, that the improvement will be slow. In any event, we have "turned the corner." It is far healthier for business to be looking uphill than to be putting on the brakes and trying to avoid the dangers of a rapid downward descent.

Unemployment Statistics

FIVE and three-quarter millions was the estimate of decrease of employment between the peak of 1920 and July of this year made during the summer by the Department of Labor. At the Unemployment Conference this figure was challenged. The National Industrial Conference Board puts present unemployment at 3,500,000, and, judging by the testimony at Washington, the correct figure is probably not far from 4,000,000. Even this, however, is not a figure of normal unemployment—that is, unemployment of those who naturally work for a living—but is a measure of the decrease of employment from the high figures of last year. The situation, therefore, is not as serious as the country was led to believe from the figures put out by the Department of Labor. Nevertheless, the activities springing out of the Unemployment Conference are fully demanded by present conditions.

Aggravated Sludge

THE *sceptic* tank has now been followed by *aggravated sludge.* Curiously enough, and quite fittingly; some will think, "aggravated" sludge is coupled, in this latest newspaper nomenclature, with the Imhoff tank. Thus the *Herald,* of Brownsville, Tex., in its issue of Aug. 5, announces that: "The construction of an Imhoff sewage disposal tank, with the aggravated sludge" at a cost of $15,000 is proposed by "visiting sanitary engineers," or as an alternative "an Imhoff tank" and a "carry off sewer line" to the river at a cost of $65,000. Engineers can guess what is really intended, even if the citizens of erstwhile turbulent Brownsville are left in the dark, but the best of engineers will be puzzled to know what one of the visiting engineers really had in mind when the *Herald* represents him as speaking of the "evaporation process" as a possible way of disposing of the "water" from the proposed sewage-works. Thus do the daily newspapers, in places large as well as small, enlighten or darken the public mind on municipal engineering projects.

Business Men or Statesmen

THERE is always danger in trying to dismiss with brief comment a subject involving the welfare of great states and their millions of population. Nevertheless, we do not want to let go by without at least a word Hugo Stinnes' remark to Isaac F. Marcosson as reported in the Sept. 24 issue of the *Saturday Evening Post.* Said Stinnes: "The whole world is sick and the politicians of Europe give it no opportunity to get well. A few business men sitting around a table, discussing matters calmly and amicably, could achieve more reconstruction than all the chatter of self-seeking politicians. The curse of Europe is politics, and until the politician is eliminated there can be no stabilization."

Most men, we believe, are willing just now to rail at the statesman, and to assent to the generalization that too often he is nothing but an international politician. We are not so sure, however, that the remedy lies in turning the job over to the business man, except as a temporary assignment. For the minute, he would probably be willing to overlook all past jealousies and stick to the task of working out a solution that would make for quick world readjustment. We are inclined to doubt, though, whether as a long-time director of international adjustment his results would be better than those achieved by the statesmen of the past. Surely the latter have had an economic, a business ideal. Territorial expansion, trade penetration, international alliances have been dictated on economic grounds. Certainly the international business relations before the war should have deterred business men from the cataclysm. That they did not may be chargeable to the over-ruling of their views by war-lords, but business had long been intimate and in accord with the military powers.

Could the business men be relied upon to do that which was best not for business, not for business men as distinct from the rest of the community, not for the glory and perpetuation and strengthening of a dynasty or of a political clique, but rather that which was good for the masses in their respective countries, something might be gained in passing over to them the powers now, and hitherto, lodged in the statesmen. Without such purpose, however, we could hardly look for more from them than we have received from the international politicians who have directed Europe's destinies.

Again we say that this is too big a question to be dismissed with brief comment, but even a few words may help to stimulate the thinking of our readers in this important direction.

Public-be-Damned Policy of the Building Industry

"CROOKED business agents, ignorant and poorly-balanced workmen, selfish and narrow-visioned contractors, greedy material dealers, all are taking part in what is in effect a conspiracy to ruin Chicago." Thus the *Chicago Tribune,* in a recent editorial discussion of Judge Landis' decision concerning wage adjustment in the building trades, characterizes the local building industry. The *Tribune* extends to Judge Landis its sympathy in his endeavor to fix a scale equitable to all concerned, asserting that compared to his task of "cleaning up the Chicago building trades the labor of Hercules in the Augean stables is as the parlor maid's difficulties in dusting the grand piano."

Repudiation by labor organizations of their pledge to abide by the decision and their request for a rehearing as well as the action of contractors in continuing the old scale after the new was announced, merely to avoid labor difficulties, are the reasons for the well-deserved censure. It is just such actions that account for the public's lack of faith in the building industry. One decayed apple in a basket will soon ruin the rest. A group of crooked transactions undermines confidence in the whole industry. Much is being said about the need for securing public confidence by stabilizing material prices and wages, and giving honest effort for a day's pay. But such incidents as have been brought out in

New York, Chicago, and Buffalo through legislative investigations, and in other cities through other means of publicity, have set back far the restoration of public confidence. Judge Landis, the agent of mediation and the representative of the public in the Chicago case has found out too well that a pledge is not inviolable. The industry will not clean itself; it will not allow others to help in the process. The penalty is protracted public suspicion, with inevitable but difficult-to-estimate losses to all concerned. In the end may come some form of public regulation, for the public in the past has stepped in and thus protected itself against those who infringed its rights.

Airplane Photographic Maps

ENGINEERS with a vision cannot fail to see in the development of the airplane photographic map a new tool with a wide variety of engineering uses. The mosaic map, however, has been so generally identified with war-time operations that its field of application in civilian practice is just beginning to receive recognition. Both in the technique of aerial map-making and in the equipment employed therefor substantial progress has been made since the signing of the armistice. Private enterprise, aided by governmental co-operation, has taken the development of the art where the army left it and carried it forward to a point of commercial practicability.

A number of cities today are using or planning to use aerial photographic maps in connection with such a wide range of engineering studies as city planning, traffic control, water-front improvements, transit facilities, location of new schools, street widening and fire protection. These, of course, are distinctly municipal uses, as pointed out in the article on the general subject of airplane mapping, appearing elsewhere in this issue, but in addition such maps offer possibilities in the preliminary investigation of watersheds, hydro-electric developments, highway, railroad or canal location, forest surveys, etc. Comparatively few engineers have sensed the application of the airplane map to the solution of many problems upon which they are now engaged. With such innovations as the automatic timing of exposures to cover the proper ground area and at the same time secure the necessary overlap for the accurate fitting together of individual negatives, lenses especially adapted to this type of work, development of the technique covering such details as the best height from which to take pictures for specific purposes, speed of the airplane, and the maintenance of a level flight to insure verticality in the view, the maps now being produced attain a high degree of accuracy and a wealth of valuable detail. Among the points worth considering in connection with airplane photography in engineering work are the speed with which such maps may be produced, their ability to cover territory inaccessible on foot, their comparatively low cost, and the impossibility of omitting any feature of the area photographed—the detail, of course, depending upon the altitude and the characteristics of the lens employed. Most of our larger cities are concerned with the problem of handling the ever-increasing volume of street traffic. In this field, alone, the airplane photograph offers extremely interesting possibilities.

The advent of the mosaic map, of course, does not mean that such time-tried tools as the transit and stadia or the plane-table are to be discarded. They have now, and always will have, a distinct field of usefulness. Airplane mapping, however, has already established itself as a practical means of securing quickly, cheaply, and accurately information which can be put to a wide variety of uses in engineering practice. Engineers who think of surveys only in terms of the old field tools may soon find themselves out of date.

Health Association Jubilee

THE "HEALTH FORTNIGHT" of the American Public Health Association in New York City, Nov. 8 to 19, has been planned on a scale worthy of an organization that is looking backward over a half century of useful existence and forward to an even brighter and more fruitful career. In the fifty years of the existence of the association a small band of devoted seekers after scientific truth and efficient methods in the field of public health, working for the most part blindly and stumblingly along empiric lines, and with little or no governmental backing—municipal, state or federal—has grown to a goodly army of trained public-health administrators and research students. The omnibus conventions have given place to many sectional meetings, run in parallel, and a few general sessions of all-inclusive appeal. Meanwhile, the annual proceedings, made dull by their bulk and age, have been superseded by a live and useful monthly journal and a frequent news letter. Supplementary to the association is the National Health Council, that is co-ordinating the scores of public and private health agencies of the Americas.

Of the many lines of work now separately conducted by the American Public Health Association, those of most interest to readers of this journal center in the Sanitary Engineering, Laboratory, Vital Statistics and Industrial Hygiene sections. In these fields, whether before or since the sectional organizations were effected, the most notable work has been the formulation and revision of standard laboratory methods for the examination of water, sewage and milk; a long series of reports and papers on garbage disposal, for which through many years the association and the country at large was chiefly indebted to Rudolph Hering, who is still a member of the committee now in charge of the subject; a pioneer report on disinfection and disinfectants, and much work on the standardization of vital statistics. Today, the various sections combined, through committees or otherwise, are dealing with scores of phases of public-health work.

A unique feature of the Health Association Jubilee is the holding of a Health Institute in New York the week before the convention—an experiment that may well be watched by other organizations. The institute will afford an original opportunity to get into intimate touch, by personal visits and other means, with the many public and private agencies, laboratories and sanitary engineering works in and near New York City. To do this during the convention, without neglecting the convention itself, would be impossible; and to do it without organized assistance would mean either a great loss of time or failure to see all that might readily be seen under guidance.

The Health Institute before and the Health Exposition during the week of the convention should ensure a record-breaking attendance at the jubilee of the American Public Health Association, and help to raise the event to a position proportionate to its importance to the public throughout the country.

Aerial Photographic Mapping Developed for Municipal and Other Engineering Services

Wide Variety of Uses Includes Traffic Studies, Street Layout and Waterfront Development—Methods and Equipment Improved Since the War—Exposures Made Automatically

(An article prepared from data supplied by FREDERIC E. JONES, *American Air Service Corp., Springfield, Mass.)*

AERIAL photography, an outstanding development of the World War as a quick means of securing information regarding enemy operations, such as troop movements and the location of batteries, ammunition and supply dumps, or lines of communication, is being put to new commercial uses in the field of engineering. Engineers, in fact, are just beginning to recognize the possibilities of the air photographs in the solution of problems relating to city planning, traffic regulation, water resources, housing conditions, water-front development and mapping of areas, such as forests, not easy of access except by air routes. As a preliminary to ground surveys for railroads, canals, highways, hydro-electric developments and scores of similar engineering projects surveys from the air and the resulting photographic maps produced by piecing together prints of films covering the areas in question, are proving of great value.

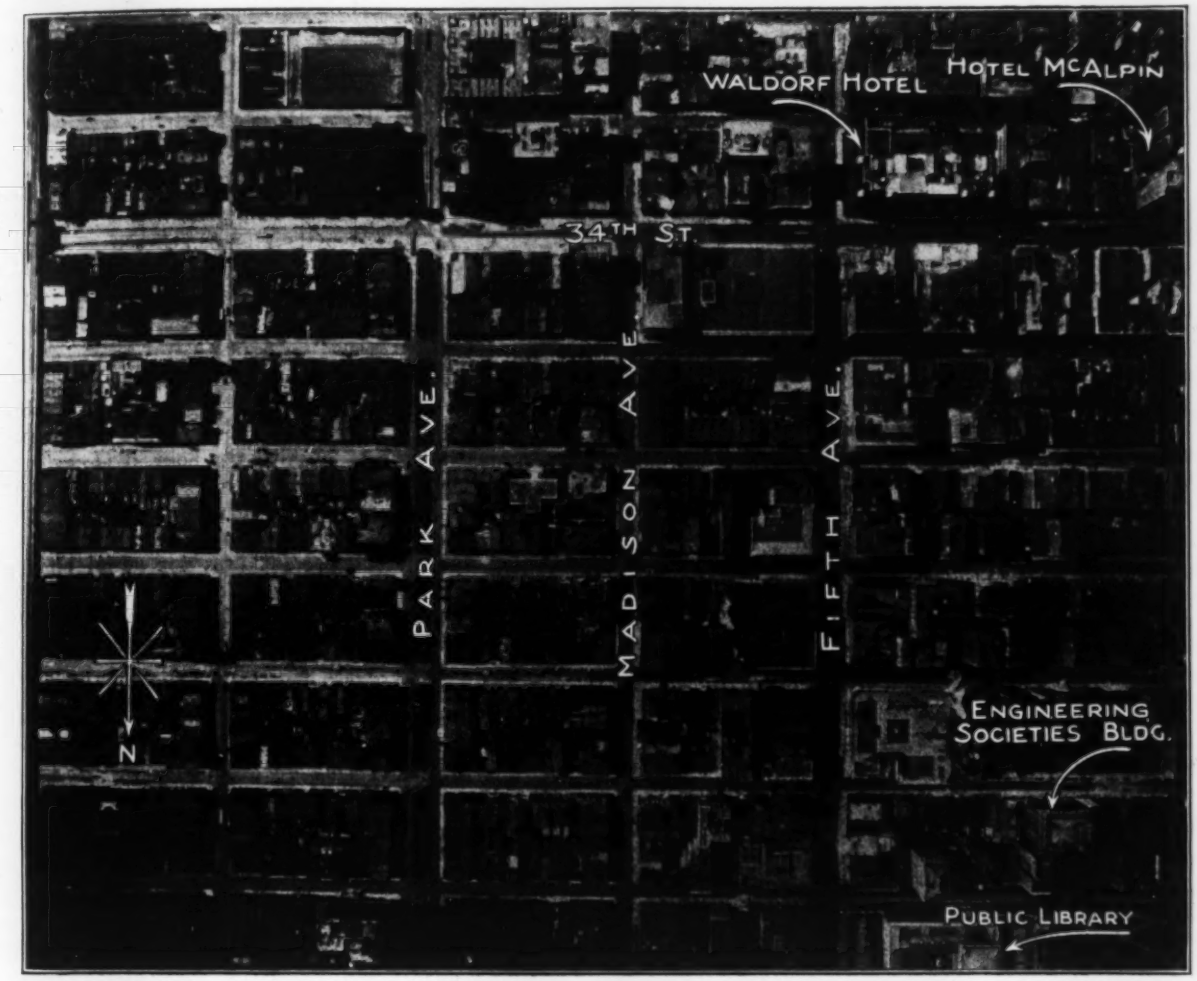
PORTION OF MOSAIC MAP OF ROCHESTER, N. Y., MADE FROM 80 NEGATIVES COVERING 30 SQUARE MILES; AVERAGE ALTITUDE 9,930 FT. AND ORIGINAL SCALE 1:9980

One of the main advantages of the aerial survey, of course, is the rapidity with which it can be made, and the great amount of detail which it can be made to show even when the photographs are taken from considerable altitudes. In fact, a number of large cities are actually using or contemplating the use of aerial maps in connection with the work of their engineering departments.

The more recent types of aerial mapping cameras are greatly improved over those used during the war, and, due to the effort of private promotion linked with government assistance, the results obtained are superior to those formerly secured. There has been developed an automatic camera, adjusted in the bottom of the airplane, by which exposures are made automatically, with clocklike precision at the correct intervals, so as to produce in the film sufficient overlap to enable the operator to join the finished pictures into a continuous map or mosaic. The usual overlap is one-third of the length of each picture. Film is used instead of plates as it is lighter and can be carried in larger quantities. In all recent work a compass, level gage, serial number, altitude gage, and time clock are so arranged as to be photographed on every exposure. These features are especially helpful in work where mosaic maps are made of city areas for traffic studies, as the time-clock automatically records the hour, minute, and second when each picture was made, thus fixing accurately the time at which traffic conditions shown on the negative existed.

Aerial photographs are of two general types, the oblique and the vertical. The oblique photographs represented the earlier development of the art. They were not entirely satisfactory for detail information over large areas, as each picture had a perspective different from others of adjacent territory, making it difficult to combine them in a single map. The oblique view, however, is useful in preliminary studies or reconnaissance work. Better results were eventually obtained by using the vertical view. Negatives made in this way are much easier to match and by enlargement or reduction they can be brought to a uniform scale even though the airplane from which they are taken does not fly at a constant altitude. In taking the vertical pictures, however, the airplane should be kept in line with the objects to be photographed and maintained on as even a keel as possible, avoiding steep banking at turns.

Mosaic maps, as now made for commercial use, show a great deal of detail and, when properly made, are generally accurate within 1 per cent; as the art develops, small errors now caused by differences of elevation of the airplane at the time of taking a photograph will be largely eliminated. The newer cameras produce negatives which show land beneath water surfaces and may



VERTICAL VIEW OF NEW YORK CITY IN REGION OF FIFTH AVE. AND 34TH ST. (ALTITUDE 4,000 FT. FOCAL LENGTH OF LENS 12 IN.)

be used in interpreting the location of deep and shallow channels.

A recent development, particularly valuable in aerial surveys of forest areas, is the use of color-sensitive plates and film which indicate the species of trees as well as their location. With the use of color-sensitive films pine and spruce can be differentiated from balsam by the difference in shade; the black spruce of the swamps is readily recognized by very dark shade in photographs. Pure jack pine stands have a distinct color and appearance. Birch can be distinguished from poplar. Elms and maples are readily recognized. When the leaves are turning in the autumn the recognition of different species is easy and tamaracks are particularly noticeable. After the leaves have fallen white birches are distinct from other hardwoods and maples and beeches show up distinctly. The boundaries of burns are easily seen and where reproduction has commenced the amount and approximate height can be easily estimated. Even when the new growth is coming up under a thin stand of poplar and white birch one can tell whether the trees are 3 ft. or 6 ft. high.

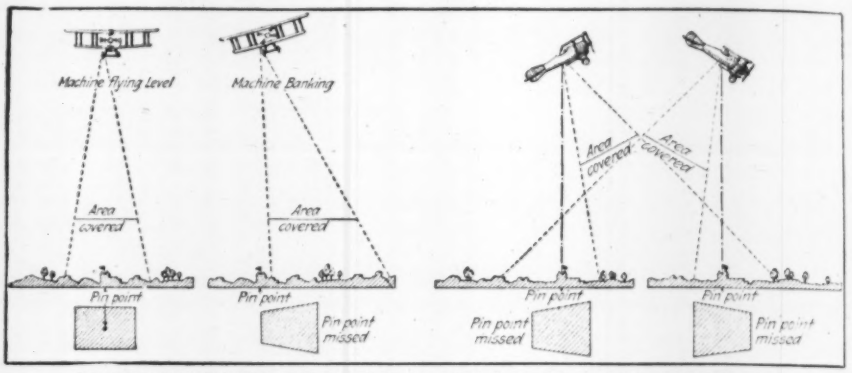
The latest type of airplane camera, developed by the Eastman Kodak Co., is mounted over an aperture in the floor of the observer's cockpit and is entirely automatic in its action, the driving power being provided by a wind motor mounted on the side of the airplane body, with a control lever easily accessible to the pilot or observer. Electric driving power is also used. Exposures are made upon a continuous roll of autochromatic film—each negative measuring 18 x 24 cm. The film is held flat at the recording plane by constant vacuum suction, thereby overcoming all vibration of the film during exposure.

The camera is fitted generally with a 12-in., 18-in. or 20-in. lens, carefully adjusted and rigidly set at infinity focus, although provision is made for readjustment of focus, if necessary. A focal-plane shutter is employed and the interval between exposures may be adjusted, depending upon the altitude of the airplane, speed, and vibration.

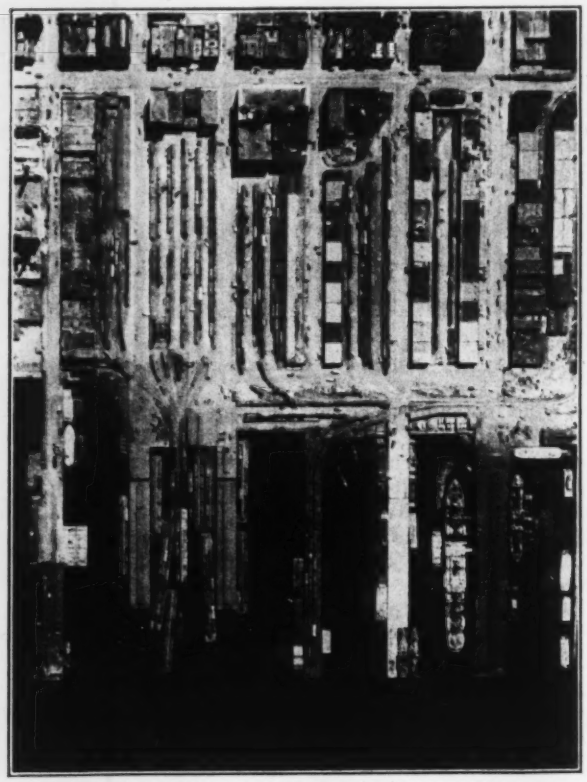
The automatic cycle of operation is as follows: After each exposure a safety curtain is interposed between the lens and the film. The film is then wound into position for the next exposure. The focal-plane shutter is reset and the safety curtain withdrawn just before the next exposure is made. The movement of the film across the recording plane is entirely automatic and continuous as the focal-plane shutter and the safety curtain are alternately released and reset between exposures.

Variation in altitude of flight is an important factor in the computation of the interval between exposures

that will produce the required amount of overlap in the negatives, thereby permitting accurate matching. Tables have been computed by the manufacturer of the airplane camera showing the number of seconds between exposures required for 25 per cent and 50 per cent overlap both for the 20-in. and 12-in. lenses, at varying altitudes and ground speeds of the airplane. Having decided upon the altitude from which pictures will be made and the percentage of overlap required in prints, the camera is adjusted, by reference to the manufacturer's tables, to make exposures at the proper intervals. For example: If the altitude is 5,000 ft. and the ground speed of the airship 90 miles per hour, the interval between exposures with a 20-in. lens will be 10 sec. for a 25-per cent overlap in the pictures and 6 sec. for a 50-per cent overlap. For pictures made at an altitude



DIAGRAMS SHOWING EFFECTS OF BANKING, CLIMBING AND DIVING ON AERIAL PHOTOGRAPH



AERIAL PICTURE OF WATERFRONT CONDITIONS TAKEN AT ALTITUDE OF 4,000 FT.

of 3,000 ft. and 80 miles per hour, the interval between exposures with a 12-in. lens is 11 sec. for a 25-per cent overlap and 7 sec. for a 50-per cent overlap. Time intervals for an 8-in. lens are shown in the table and sketch on p. 599.

Allowance must be made for any difference between the ground speed and the air speed of the airplane, due to prevailing winds and direction of flight. If an airship has an air speed of 60 miles per hour and flies against a wind of 30 miles per hour, it is obvious that the plane will pass over the ground at a speed of only 30 miles per hour, which will determine the required interval between exposures.

One of the most important uses for aerial photography today is in mapping cities and towns. The photograph on p. 596 shows part of a mosaic map of the city of Rochester, N. Y., where an area of approximately 30 sq.mi. required 80 separate photographic exposures. This map, in its original form, was at a scale of 1:9980 and the photographs were taken from an airplane flying at an average altitude of 9,930 ft. Comparison of this map with one made by ground survey methods indicated an error of less than one-half of 1 per cent. For purposes of checking, a triangle measuring 5,000 ft. on each side was surveyed on the ground at Rochester. Measurement of this triangle taken from the aerial map gave a length for each side of 4,990 ft., an error of only 10 ft. in 5,000.

In reporting on the accuracy of an aerial map of the Kalamazoo quadrangle, the U. S. Geological Survey found that the accuracy of the mosaic map was so close to that of the ground survey that when reduced three times—lessening the error by 3—it fitted "exactly with our previous survey data."

In one large city the American Air Service Corp. was retained to make a map to serve as a basis for a complete study of traffic, transit, and water-front conditions. Another city is to use an aerial mosaic as a new survey, while still another town will employ an aerial map in an investigation of housing conditions and street layout, with particular reference to the location of new schools. In a locality, where a campaign of mosquito elimination was under way, an aerial map was em-employed to advantage to show pools and ponds which served as breeding places for the pests but which were off the main lines of travel and would probably have been overlooked by the mosquito exterminators.

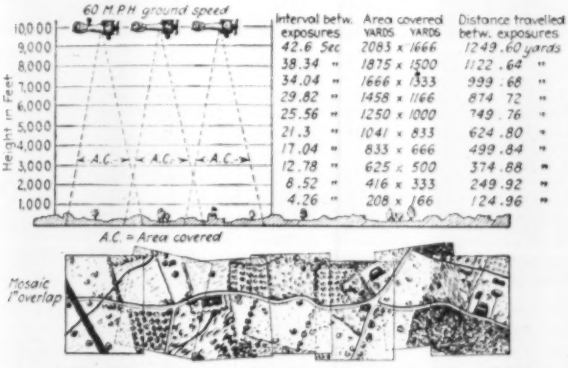
A large city which has the project of an aerial map under consideration recently received from its principal assistant engineer a report from which the following excerpts are taken:

"An aerial map of the city would show more detail than we could ever hope to put on any plan prepared from surveys. Such a map would be an invaluable aid to us on traffic studies, city plan work, regulating, grading, and repaving work, encroachment and building-line work if made at a time of peak traffic load. It would show at a glance traffic conditions of all the streets and could be used as a basis for determining

streets requiring widening where congestion exists and sparsely used streets through which it would be possible to route part of the vehicular traffic using the congested areas.

"By superimposing a proposed street layout on the aerial map it would serve to determine the extent of the damage to private property, such as buildings, and, in addition, would show the character of the neighborhood which the proposed improvement would serve. It would assist in locating retaining wall, slopes, etc., so as to minimize damage to adjacent private property. Often there has been some question as to whether or not new curb corners require the shifting of hydrants, lamp posts, etc. This question could be answered immediately by an inspection of an aerial map, whereas, formerly, it would be necessary to make a survey or field inspection. Questions as to building encroachments could be readily answered from the aerial map without the necessity of going into the field to make examinations.

"We are frequently called upon to make studies for the alignment of street-car tracks and the layout of



Interval betw. exposures	Area covered YARDS	Distance travelled betw. exposures
42.6 Sec	2083 x 1666	1249.60 yards
38.34 "	1875 x 1500	1122.64 "
34.04 "	1666 x 1333	999.68 "
29.82 "	1458 x 1166	874.72 "
25.56 "	1250 x 1000	749.76 "
21.3 "	1041 x 833	624.80 "
17.04 "	833 x 666	499.84 "
12.78 "	625 x 500	374.88 "
8.52 "	416 x 333	249.92 "
4.26 "	208 x 166	124.96 "

Table showing Intervals of Exposure giving 1" Overlap on 5"x4" Negative with an 8" Lens

OVERLAP PHOTOGRAPHS

AREA COVERED BY 8-IN. LENS AND TIME INTERVAL BETWEEN EXPOSURES

new streets in connection with the development of private property for bridge approaches, tunnel approaches, and for increasing the width of the street which would include a demolition of buildings. In such cases, particularly where several studies of a project may be made, the map would save a considerable amount of time and money.

"I have examined similar photographs of parts of this city and other cities and it is surprising the amount of detail photographs taken at an altitude of 1,000 ft. present. A photograph made of one section at this altitude shows clearly the street railway tracks, manhole heads, types of pavement, curbs, sidewalks, traffic, and even the small police stanchions."

With reference to the foregoing report, it should be stated that altitudes higher than 1,000 ft. are desirable for aerial photographs. The detail above reported, therefore, is not to be expected in aerial maps. Such features as manholes and police stanchions will not be shown clearly, but street railway tracks and traffic conditions will be definitely indicated.

By the use of panchromatic film which is very sensitive detail in shadows can readily be brought out. Negatives also may be intensified after development to show objects in shadow.

With regard to the use of aerial maps for other municipal purposes, the following is quoted from a report from a New England city: "The council could profitably utilize a photographic map of the settled portion of the town in deciding important questions of public policy. For example, by taking the area tributary to a specific school and counting the number of buildings, we could develop a ratio between the number of children of school age and the number of dwellings. At the same time, analysis of the adjacent land would indicate the ultimate probable number of dwellings and indirectly the ultimate need for school expansion. The photographic map also could be used in connection with a study of fire protection, street lights, street paving, storm-water sewers, and problems relating to police administration."

Cost

With regard to cost of aerial surveys, the American Air Service Corp., recently made the following quotations to a New England city for a map to a scale of 700 ft. to the inch:

COST ESTIMATE FOR AERIAL MAPPING

1. For mapping city areas, including high buildings, considerable traffic and congestion, per square mile	$350.00
2. For city areas, exclusive of above, such as residential sections, harbor and water fronts, etc., per square mile	125.00
3. For other city areas, such as partially developed tracts, suburban area, parks, etc., per square mile	100.00
4. In the tract involved in the city map, an approximate area of 18 sq. mi., we classify and quote the following approximate prices:	
4 sq.mi. at $350	1,400.00
10 sq.mi. at 125	1,250.00
4 sq.mi. at 100	400.00
Total	$3,050.00

When a city procures an aerial mosaic map, it has at its disposal a photographic map that can be made into a line map survey. By placing tracing paper over the completed mosaic, all information desired may be traced off, thereby giving a line map without the photograph showing. This can be done for the entire map or any particular section of same, and may be reproduced at any scale desired.

Wastes at Tannery Chlorinated To Guard Against Anthrax

To guard against the spread of anthrax germs from the new tannery of the Surpass Leather Co., Gloversville, N. Y., the wastes from the soak vats and milling drums are chlorinated. These wastes are piped to a tank below the floor level, about 18 x 67 ft. in plan and 6 ft. deep, with a working capacity of 31,400 gal. According to a description of the concrete work of the new tannery by Walter Kidde, president of Walter Kidde & Co., Inc., New York City, engineers for the plant, in *Contractor's Atlas* for September, the chlorination tank is "lined with a special acid-resisting asphalt membrane." Mr. Kidde also states that three longitudinal baffles divide the tank into four compartments, in one of which there is located a 36-in. bronze propeller, on a shaft leading to an electric motor outside the tank. At the end of each day the contents of the tank are dosed with chlorine. The required total amount, as shown by a float gage and indicator, is fed in by the dosing apparatus during the period of an hour. Meanwhile, the propeller is used to mix the chlorine and the tank contents and to keep the solids in suspension. Finally, the chlorinated contents of the tank are discharged to a sludge-settling tank, from which the supernatant clarified liquid goes to the city sewer.

Experiment on Desert Road with Asphaltic Pavement

Powdered Copper Sulphate Added to Toughen Material in Summer Temperatures of 130 Deg. Fahr.

THE California state highway in Imperial Valley includes a stretch of 22 mi. across a sandy desert, almost devoid of vegetation, where the average annual rainfall is only about 2 in. The cost of a concrete pavement in this territory was prohibitive, the division engineer reported, on account of the scarcity of water and the long, expensive haul required to bring in concrete materials. To determine whether the desert sand could be combined with asphalt to form a pavement of sufficient stability the commission laid at one end of the desert stretch a series of short sections of pavement in which several combinations of sand and asphalt were tried. This pavement was recently inspected after having been in service for a year and was found to be, for the most part, in good condition. A statement of what materials were used and what decisions were reached as a result of the experiment, are set forth in reports of the division engineer to A. B. Fletcher, chief engineer of the California Highway Commission, from which the following has been extracted:

Copper Sulphate Added to Asphalt

The temperature in this part of the desert rarely goes below freezing in the winter time, but in the summer rises to 125 or 130 deg. F. in the shade and very much higher in the sun. Under these conditions ordinary sheet asphalt would probably be unsatisfactory, but the manufacturers of Willite, a patented asphaltic paving compound, claimed that 2 to 3 per cent of finely powdered copper sulphate, added to the hot asphalt, would toughen it and reduce the penetration without increasing its brittleness. Their plan was accordingly tried.

The several sections of pavement laid were all 15 ft. wide, placed directly on the sandy subgrade which had been prepared by leveling and dragging. The only unusual feature of the subgrade was that 2 x 12-in. headers were used and were solidly staked in position. The deep headers were considered necessary because the desert winds tend to blow the sand from beneath the edges of the pavement which, in addition to weakening the shoulders, encourages burrowing by desert rats and other small animals.

In all of the several combinations tried, the materials, obtained near the roadside, were heated in a standard asphalt mixing plant and combined with grade D asphalt of 40 to 48 deg. penetration, to which copper sulphate had been added. The amount of asphalt used varied from 6 to 14 per cent, depending upon the coarseness of the aggregate. The mixed materials were then hauled and placed by methods usual in handling asphaltic paving materials.

The first section, 1,600 ft. long, was built up of two layers, the first layer 3 in. thick and the top layer 2 in. thick, with a paint binder-coat applied to the top of the first layer before spreading the second. The materials for this stretch were obtained from an old sea beach and approximated a Topeka mixture in character. The specific gravity of this pavement was about 2.30.

The second section, 400 ft. long, was built with what is commonly called "desert blow" sand, which is so fine that 90 per cent will pass a 100-mesh sieve and about 50 per cent will pass a 200-mesh sieve. The specific gravity of this pavement was about 1.80. This stretch was also built in two layers, the lower 3 in., and the upper 2 in. in thickness.

The third section, 1,300 ft. long, was built with a medium grade sand obtained from a small pit about three-quarters of a mile from the mixing plant. From 5 to 10 per cent of this sand passed the 80-mesh sieve and the specific gravity of the pavement was about 2.16. A part of this section was made 5 in. thick, laid in two courses, and part of it was laid as a single-course, 3-in. pavement.

The fourth section, a few hundred feet long, was made of desert-blow sand which it was planned to lay as a single course, 3 in. thick. However, on account of the difficulty of rolling and getting a reasonably smooth surface, the thickness was increased to 4½ in., made up of a 2½-in. bottom course and a 2-in. top course.

In a fifth section, also several hundred feet long, the medium grade sand was used and because it was of a uniform grade some of the fine desert-blow sand was added to improve the grading, the percentage of asphalt being increased accordingly.

Effects of Cold Weather Studied

Immediately after finishing the work the mixing plant, which weighed 18 tons and had a compression on the rear steel-tired wheels approximating 1,000 lb. per linear inch of tire, was hauled over the completed pavement without marking it or damaging it in any way.

The pavement came through the summer season without cracks of any description, nor were there any signs of movement or of the effect of traffic during the hot weather. However, an inspection was made Jan. 27, on a morning following a freeze and at a time when the pavement had probably reached an average temperature lower than any it had undergone previously. This inspection showed about 30 transverse cracks of various sizes, confined almost entirely to the 3-in. and 3½-in. pavements. With the exception of two very small cracks there were none in the approximately one-half mile of 5-in. pavement.

The cracking seemed to be confined to the portions of the pavement which were made with a relatively small amount of asphalt and with an insufficiency of fine aggregate. No cracks appeared in the pavement made with the desert-blow sand and which contained 12 or 13 per cent of asphalt.

Pavement made with the desert-blow sand, which was thought by the engineers in charge likely to prove the least satisfactory of any of the experimental sections, withstood the heat of summer without perceptible softening and came through the winter without any cracks, although in most cases the thickness was only 3 in. However, it is recommended that no more such pavement be constructed of 3-in. thickness because the extremes in temperature are much more severe on such a pavement than upon one 5 in. thick.

A later inspection of the pavement made in July of this year showed that the cross cracks due to shrinkage had become filled with sand and could not close with the arrival of hot weather. Otherwise the appearance of the pavement was the same as it was a year ago.

Automatic Regulation of Locomotive Cut-off

Tests have recently been conducted on the Big Four R.R. to demonstrate the mechanical possibilities of an apparatus to regulate locomotive cylinder cut-off automatically from the back pressure. The device employed consists of valves connected to the four exhaust passages of the cylinder which actuate the air supply for the power reverse gear; a circular quadrant to limit minimum cut-off at higher speeds, but to permit the reverse lever to follow the gear and indicate the cut-off as well as to provide a quadrant for operating under hand control. An auxiliary to the device is a control valve connected to the throttle, requiring full throttle opening and placing the engine under control of the automatic cut-off apparatus. Comparative tests are reported as demonstrating that it is possible to regulate locomotive cut-off by automatic means to the point of maximum economical capacity within the practical limits of load and speed.

Arkansas River Dammed by a Single Large Blast

Portion of Rock Cliff Blown Into River to Force Additional Water Into an Old Irrigation Ditch

BY IVAN E. HOUK
Miami Conservancy District, Dayton, Ohio

A DAM was thrown across the Arkansas River, about 14 miles above Pueblo, Colo., on Aug. 21, 1921, by blasting down an overhanging rock cliff in one large shot. A portion of the cliff about 60 ft. high, 30 ft. thick and 45 ft. long was dislodged. At the bottom the rock was sandstone without seams, and above it was limestone and shale in comparatively thin strata. Fig. 1 shows the cliff, before the blast, from a point about 400 ft. upstream, and Fig. 2 is a view from the same point showing the dam which resulted from the blast.

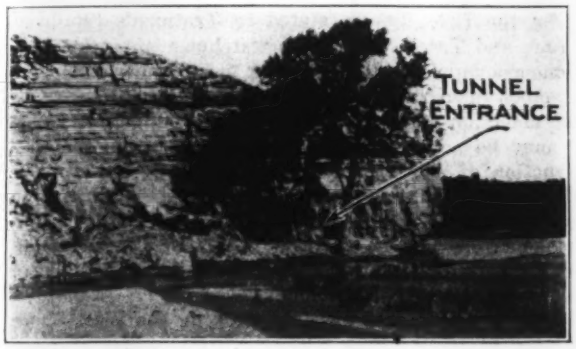


FIG. 1. VIEW SHOWING CLIFF BEFORE THE BLAST

FIG. 2. DAM MADE BY BLASTING CLIFF INTO RIVER

The dam was made necessary by channel changes which occurred during the recent flood. Before the flood the main channel of the stream was on the south side of the island seen at the right of the river in Fig. 1, where a dam diverted a part of the flow into the Bessemer irrigation ditch. During the high water, however, a new channel was scoured out along the bluffs. After the flood subsided nearly all of the flow continued along the new channel, so that the head on the ditch headgates was materially reduced. Prior to the blast the ditch had been getting about 70 sec.-ft. Within an hour afterward 775 sec.-ft. were passing the headgates and the ditch was taking its full capacity of about 300 sec.-ft.

The charge, which consisted of 5,000 lb. of black powder, with 50 lb. of dynamite scattered through the powder in order to give better ignition, was placed in the end of a tunnel driven into the cliff near its base. The entrance to the tunnel may be seen at the left of the tree in Fig. 1. It was 4 ft. wide and 6 ft. high and was driven straight in for a distance of 35 ft., then offset 5 ft. to give a better control of the blast, and then driven 10 ft. further. The charge was placed in the last 10 ft.

About 300 lb. of dynamite were used in driving the tunnel. Holes were drilled 18 in. deep, then shot, and the rock cleaned out. It required 14 days to complete the tunnel, working three eight-hour shifts of two men each. The entire cost of the work did not exceed $2,000.

The work was done by Arthur, Potter & Allen, contractors, of Pueblo, Colo. C. K. McHarg is secretary of the Bessemer Irrigation Ditch Co.

Repairs to a Wind-Indented Standpipe at Bath, Maine

BY C. E. CARTER
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

Abstract of a paper read before the New England Water Works Association, September, 1921.

DURING a heavy gale, Dec. 14, 1917, the easterly side of the 34 x 74-ft. wrought-iron standpipe of the Bath Water District (Me.) was blown in or indented by wind pressure. The records of the Weather Bureau of Portland, Me., show a maximum wind velocity at this date of 60 mi. per hour. The standpipe was built in 1887 by the New England Shipbuilding Co., Bath, Me. The contract called for "C. L. Bailey's refined iron stamped 'Central' or iron equally good" with a tensile strength of not less than 50,000 lb. per square inch. The standpipe was built with plates of five different thicknesses, each three rings from the top downward having thicknesses as follows: $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{5}{8}$ in. All joints were lapped. All vertical joints were double riveted and all horizontal joints were single riveted, except that those on the lowest side of the bottom sheet were double riveted. The top of the upper ring was reinforced by a 3-in. angle iron in short lengths.

WIND-INDENTED STANDPIPE, BATH, ME.

From the time of the accident until the latter part of the summer of 1919 the standpipe was kept filled to a depth of 40 ft. At the time mentioned the contract for repairing the pipe was let to the Bath Iron Works.

The repairs were made from an outside staging and an inside float, with steam hoists for raising and lowering the plates, and an air compressor for riveting.

A total of 27 plates was removed. Of these all except three that were too badly damaged were hauled to the shop, re-rolled, hauled back and replaced. The top of the upper ring was reinforced by a 6 x 6 x

⅝-in. angle iron, in 18-ft. lengths, and anchored to rock about 100 ft. from the standpipe base by means of four 1-in. wire guys.

The repairs were made in 49½ days, during which the structure was entirely out of service for only the six days required to place 1 ft. of concrete in the bottom and paint the structure. The total cost of the repairs was $7,138, of which $5,409 were for repairing the plate, $1,438 for the guys and concrete bottom, and $292 for painting. The contract price of the original structure was about $8,000. Both details and cost data were supplied by Walter F. Abbott, superintendent of the Bath Water District.

Protection of Railway Track from Falling Rocks

Slopes Inspected and Cleared — Watchmen During Troublesome Season—Securing Rocks in Place—Removal of Slides

ON RAILWAYS traversing rocky canyons and steep mountain slopes special precautions have to be taken to protect the line from rock slides and falls of loose rock. Periodical inspection of threatening points is necessary, as the washing of steep slopes by storms and drainage or the alternating conditions of freezing and thawing of moisture in crevices of the rocks, tend to loosen or disintegrate large rock masses from time to time. Such inspection is usually under the direction of the engineering or maintenance of way department.

More trouble from steep rocky slopes than from vertical cliffs or bluffs is found in some cases, since the latter are largely monolithic, presenting comparatively few seams for the collection of water and being secure against the undermining effects of erosion. On the other hand, steep slopes are formed largely by disintegration, which is a continuous process, so that crumbling under atmospheric influences and erosion due to washing result in producing instability of the slopes. Geologic conditions are among the factors affecting individual localities. Seasonal and meteorological conditions are largely responsible for falls of rock, experience indicating the portions of line to be watched and the weather indicating when falls may be expected.

Day and night patroling by special trackwalkers or watchmen is a general precaution at points where falls or slides are likely to occur. At certain times these men may be required to patrol their sections before and after every train. Shelters must be provided for them, as they work largely during severe weather. On some roads the rules require the entire section gang to carry on such patrol duty during heavy storms or under such a combination of circumstances as very warm days followed by cold nights when there is a deep blanket of snow on the slopes. The watchmen are provided with flags, lamps and torpedoes for stopping trains in case of emergency. Telephone booths are often installed near points of potential danger, so that if rocks or slides foul the track the watchmen can not only warn the trains but also notify the train dispatchers to hold traffic and send the necessary equipment for clearing the track.

Inspection of slopes and cliffs is undertaken according to local requirements. When slopes are to be cleared, extra gangs are organized as a rule, the removal of large loose or threatening masses being effected usually by the aid of ropes, bars and explosives. Along high bluffs it is often necessary to lower men from the top to make inspections or clear away loose rocks. Trains may be held up occasionally, but most of the work can be done in the intervals between trains. During such work the track is frequently covered with old timbers to protect it from damage by the material thrown down and to facilitate removal of the debris by a steam shovel or ditcher without injury to the track.

Much of the material is likely to require a derrick car or locomotive crane to remove it from the track, the smaller material being handled by a steam shovel or ditching machine. The material may be loaded into cars and used for widening banks or filling trestles, but in some cases it is practicable to throw it clear of the track on the downhill side. If a stream flows near the railway, care must be taken not to obstruct or restrict the waterway by this waste material. Side ditches of liberal width afford good protection against the smaller pieces of rock which fall down rocky slopes.

On the Erie Ry., as stated in Tratman's "Railway Track and Track Work," the watchmen on rocky divisions are supplemented by a rock gang composed largely of quarrymen who are experienced in climbing and in the detection and removal of loose or dangerous rocks. It may be noted also that immediately after the construction of the Spokane, Portland & Seattle Ry., in 1907, a number of large rock gangs were organized to go over the work along the banks of the Columbia and Snake rivers for the purpose of clearing and dressing the slopes. As a result it is stated that rock slides have been comparatively infrequent.

A very exceptional piece of work on the West Shore R.R. in securing a loose 6,000-ton mass of rock in place by long 10-in. steel pins grouted in holes drilled through to solid rock, in order to protect an adjacent bridge, was described in *Engineering News* of Aug. 24, 1916, p. 358. Another case mentioned in the same issue was the building of concrete walls to support ledge rack left overhanging the Pennsylvania R. R. by the disintegration of an underlying stratum of clay. This was along the face of Mount Washington, opposite Pittsburgh. In recent years, concrete facing applied in ordinary ways or by means of cement gun has been applied to rock cuts to close seams and fissures and to prevent weathering. In rare cases concrete or masonry galleries have been built on European railways at points where rock falls are frequent.

Tension Tests of Steel at High Temperature

High-temperature tension tests of various steels conducted in the laboratory of the Allis-Chalmers Co. and reported at the recent meeting of the American Society for Testing Materials showed a sharp drop in the tensile strength for most steels, especially when heat-treated, at or somewhat below 800 deg. F. Usually a maximum in strength occurred shortly before the drop; the author concluded that the maximum tensile strength of annealed rolled carbon steel and forged 3½ per cent nickel steel occurs between 600 and 650 deg. F. He found the larger percentages tended to lower the temperature at which tensile strength began to decline. A steel containing nickel was the only one in which the ductility materially diminished at the higher temperatures; but the same property was observed in one set of forged monel metal bars. Alloy steels containing chromium were less affected by temperature rise than carbon steels.

Coaling Barge Combines Dragline Bucket and Conveyor

Simple Coal Handling Unit at Galveston Requires No Shipboard Equipment—Designed for Flexible Operation

A COALING BARGE combining a dragline bucket and a belt conveyor in a simple coal-handling unit of 1,000 tons capacity has recently been put in operation at Galveston, Tex. This barge carries the entire equipment for transferring coal to fuel bunkers of steamers, or to the cargo hatches when the steamer is carrying coal as cargo, without the necessity for shipboard equipment. It was designed primarily for flexibility of operation, which is performed by two men, an engine runner and a fireman. The barge itself, which carries a steel tower, has its own boiler and power equipment for driving, hoisting and dragline cables and for operating the belt conveyor and the crosshead carried on the steel tower.

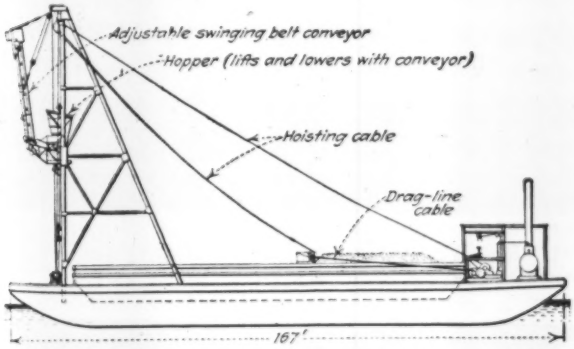


FIG. 1. SHIP COALING UNIT EMBODIES DRAGLINE AND CONVEYOR

An outline side elevation of the barge is shown in Fig. 1 and a photograph of the plant in operation is shown in Fig. 2. Coal is handled from the self-trimming barge (see Fig. 3) by a scoop bucket of 1½ tons capacity, controlled by the hoisting and dragline cables. Driving power is supplied by a 10 x 12 double cylinder engine in the stern of the barge, which has two drums set in friction by air cylinders. The front drum operates the dragline, which pul's the bucket lengthwise of the barge through the coal until it fills, by a line passing between sheaves at the front of the bucket and made fast to a shackle on the swinging bottom, as indicated in Fig. 4. Thus the bucket is closed fast while the strain is kept on the dragline until it is over the hopper, where it can be dumped by slacking off on the dragline cables. The rear drum operates the hoist line which runs over a sheave at the top of the steel frame at the bow of the barge, down through a block attached to the bucket, and thence back to the top of the framework, giving a two-part purchase for hoisting the loaded bucket. From the hopper, which is of five tons capacity, coal is fed into a Robins belt conveyor ,which delivers it to the steamer bunkers or cargo hatches.

The crosshead or frame, carrying with it the hopper and conveyor, is raised or lowered to any elevation, within operating limits as required by the height of vessel to be coaled. Two hoists located at the foot of the tower, operating independently, lower and raise the crosshead and the end of the belt conveyor to any

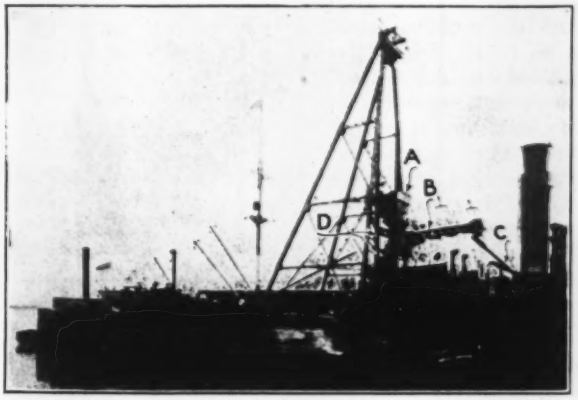


FIG. 2. BARGE IN OPERATION WITH AUXILIARY CHUTE FOR COALING WITHOUT SHIPBOARD EQUIPMENT
(A) hopper; (B) belt conveyor; (C) auxiliary chute; (D) crosshead frame carrying hopper and conveyor.

required height and angle. Both hoists are self-locking, holding the hopper and conveyor frames safely at whatever height or angle is required without the use of brakes or pawls. The five-ton hopper capacity gives a sufficient storage margin for operating contingencies of bucket and conveyor.

The conveyor with its supporting boom is 31 ft. long and is driven by a motor housed almost directly under the hopper and supplied with current from a 10 kw. turbine generator set in the engine house, which also supplies current for lighting. The conveyor works at any point between an upward angle of 20 deg. and a downward angle of 15 deg. and can be raised practically to a vertical position for housing while moving the barge. It swings through a horizontal angle of almost 180 deg.

Coal is delivered by the conveyor to a chute, leading to either bunker, cargo hatches or pockets. The chute

FIG. 3. DRAGLINE BUCKET DIGS OVER THE KEEL

is of light steel construction and readily shifted when desired. It is pointed out that this arrangement, adapted to the attachment of an auxiliary chute in almost any position at the end of the conveyor, results in a very flexible handling unit suitable for almost universal service in coaling operations. Another major advantage is claimed from the bucket always digging over the keel, thus avoiding listing from unbalanced load in the barge.

In operation, the barge is loaded at the coal storage yard of the coal company by means of a Lidgerwood coal transfer. The barge is then placed alongside a ship, and the hopper, with conveyor, raised to the required height to clear the ship's sides. The conveyor is next swung so that the chute will reach the hatches amidship or on either side of the ship or side pockets. The bucket takes the coal from the barge; discharges through the main and feeder hoppers on to the conveyor, which carries and drops the coal through a chute directly into hatches or side pockets. This is done without any hopper or apparatus on the deck of the ship, and without the necessity of transferring coal or receiving hoppers on shipboard. With this device, the operation of coaling goes on without interference with handling ship's cargo, and without the use of any ship's gear.

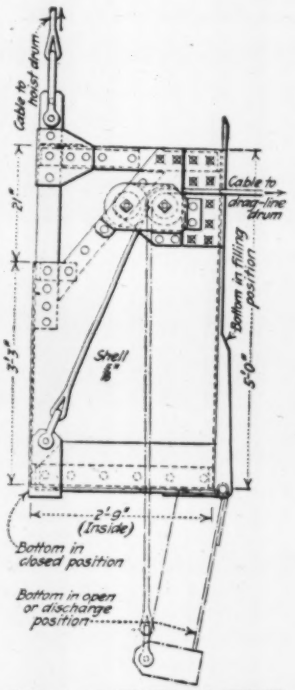


FIG. 4. BUCKET IN VERTICAL OPEN AND CLOSED POSITIONS

The handling capacity of the barge is limited rather by the receiving capacity of the steamer than the capacity of handling machinery. An average of 100 to 110 tons of coal per hour is about the maximum that can be received, stowed and trimmed. About 60 tons of coal per hour is the average stowed and trimmed in the bunkers.

The barge is operated by the Galveston Coal Co. under the supervision of Wesley Merritt of that firm. It was designed and built under the Evans and other patents by the Lidgerwood Manufacturing Co., New York City, owners or licensees of such patents.

Revised Road Regulations in Britain

The committee appointed to investigate British motor speed conditions will shortly present its report to the Minister of Transport. The recommendations of this committee are based not only on the general convenience of road users but also on the preservation of the road surfaces to which all users are, in some form or other, compelled to subscribe. It is likely that all steel-tired vehicles will continue to be restricted to 5 miles per hour, motor coaches, omnibuses and chars-a-bancs to 16 miles per hour and other vehicles, not over a certain weight, and shod with pneumatic tires will be restricted to 24 miles per hour.

Progress On Pit River Project In California

First Plants Completed—Large Units and High Voltage—Construction Program Laid Out for Next Ten Years

DESPITE unfavorable weather conditions during the winter of 1920-21, construction on the several plants of the Pit River hydro-electric project in Northern California was carried on without interruption and the first plant in the series, Hat Creek, No. 1 was completed and put in service Aug. 22. Work has also been under way simultaneously on two more plants, Hat Creek No. 2 and Pit River No. 1. The former was to be ready early in September and the latter by June of next year. Plants lower down the river, Pit River No. 2, 3 and 4, are being given further study, such as borings at dam sites, comparisons in cost of length of conduits and height of dams, etc., and will probably be constructed in their numerical order.

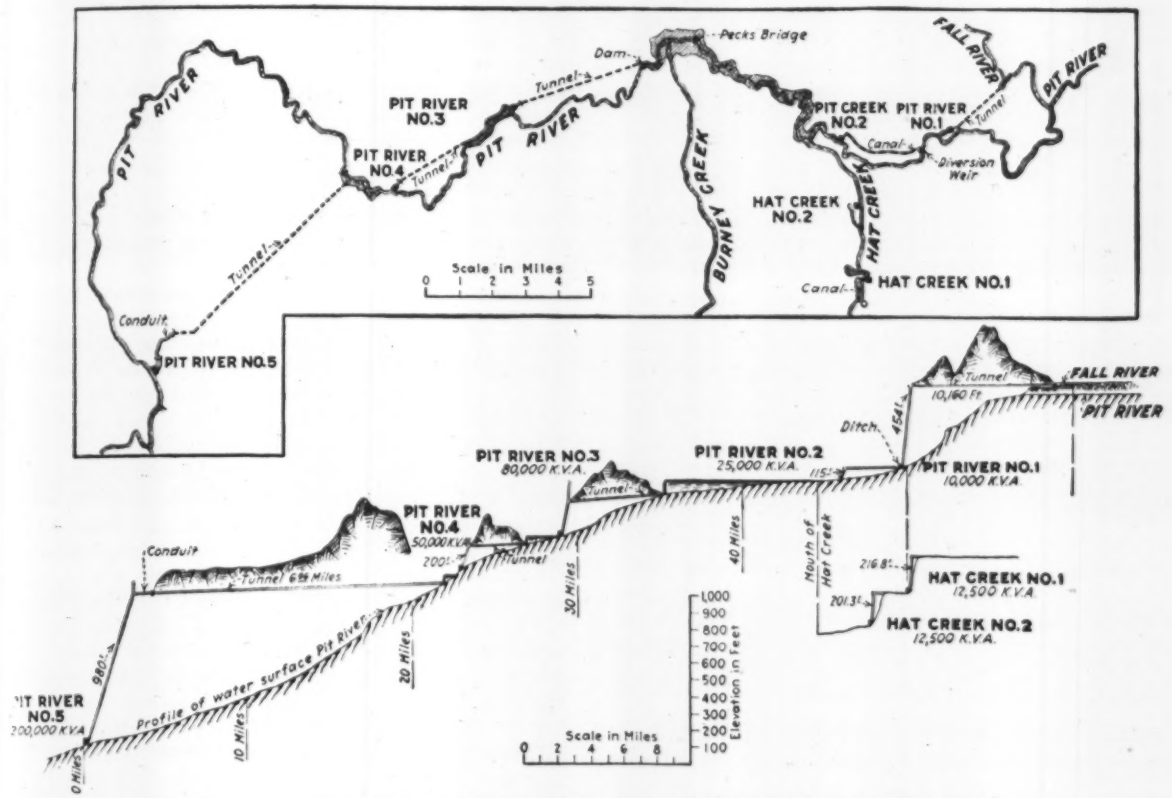
The complete series of plants contemplated on this stream is expected to add about 600,000 hp. (installed capacity) to the company's system. This amount of energy is estimated to be enough to take care of the company's load-demand increases for a period of 10 years or more. The development program is being laid out so construction will be continuously under way during this period, the plants to be completed and put in service as needed. A résumé of plans for the Pit River development appeared in *Engineering News-Record* Sept. 16, 1920, p. 575, but the plants mentioned there as Fall River No. 1 and 2 are now known as Pit River 1 and 2. Numbers on the other Pit River plants have also been changed.

Features of this development will be the 220,000-volt transmission line, the 7-mile, 3,000-sec.-ft. tunnel on Pit River No. 5 and the 40,000-hp. reaction turbines under 454 ft. head in Pit River No. 1. The relative position of the plants is such that only about 21 miles of conduit were required for serving all seven plants. The flow of the Pit River is so uniform, that no storage has been provided for any of the plants thus far built and only very low diversion dams are required. In this respect the stream is unlike other California rivers.

33 Miles of Railroad Built

Studies of truck versus rail transportation brought out the fact that due to rain and snow conditions trucking operations could be carried on in the districts between these plants and the Southern Pacific R.R., for only about five months of the year, while a railroad line could probably be kept open all year round. Rail transportation was believed to be cheaper and to assure a more dependable schedule of delivery. The question of where to locate the railroad was affected to a considerable extent by the time element. The value of the power developed in Pit River No. 1 plant for 80 days, for example, will amount to half a million dollars. Hence it was important to find a railroad route which would not delay the construction of so important a plant.

The most direct route to the Pit plants would be from some point on the Southern Pacific south of the Dunsmuir-Sisson grade in the vicinity of Redding, but this would have required some 70 miles of construction through rough country. The route selected is above the Dunsmuir-Sisson grade and does not



PLAN AND PROFILE OF PRESENT AND PROJECTED WORK IN PIT RIVER BASIN

connect with the Southern Pacific direct but starts from the end of the McCloud River Railroad at Bartle. From this point, however, it was found possible to locate a line to Pit River No. 1 power house which is only 33 miles long and has a maximum gradient of 4 per cent and a maximum curvature of 15 deg.

Surveys on this line were begun early this spring when there was still 10 ft. of snow over some parts of the route. Grading was started May 20. Track had been laid 13 miles from Bartle by Aug. 15 and the entire line was to be ready for service Sept. 15, about 115 days after construction began. No tunnels or large bridges were required and the yardage moved averaged about 3000 cu. yd. per mile, making the cost of the line about $16,000 per mile. The line is standard gage and has 50-lb. rails.

Pending the completion of the railroad, trucks were used to take in supplies over the wagon road from Bartle. Most of the supplies for last winter's use were taken in in the fall while the roads were still passable and stored at the several camp sites. Emergency supplies were taken in during the winter on sleighs. The penstock for Hat Creek No. 1 and No. 2, for example, all went in during the winter, the usual requirement being 12 horses per sled. These penstock sections are 33 ft. long, 9 to 10 ft. in diameter, and weigh 8½ tons.

One Thousand Nine Hundred Men in Camps

About 1,500 men are now employed in the camp of the Pit River Basin working on tunnels, railroads, power houses and other phases of the development; and about 400 men are engaged in constructing the 220,000-volt transmission line. This line is now being built from Pit River No. 1 to Vacaville, a distribution center 205 miles from the Pit River plant and about 60 miles from San Francisco Bay. The line is to be finished by July 1, 1922, as is also a $1,250,000 substation at Vacaville.

DETAILS OF FIRST THREE PLANTS, PIT RIVER PROJECT

	Hat Creek, No. 1	Hat Creek, No. 2	Pit River, No. 1	
Static head, ft	216.8	201.3	454.0	
Normal flow, sec.-ft.	400	600	1,400	
Normal output, hp.	7,900	10,200	60,500	
Diversion:				
Type of dam	Crib	Crib and piling	Radial gates	
Height of dam	5′	6.5′	About 15′	
Conduit:				
Type	Open ditch	Flume	Canal	Tunnel
Length, ft	2,750	4,469	1,150	10,111
Size	17′ bottom 9′ depth	16′ 3″ bottom 7′ 0″ depth	50′ bottom	Horseshoe 13.5′ high
Grade ft. per 1,000	0.25	0.7	....	3.0
Max. cap'y, sec.-ft.	600	800	1,800	
Surge chamber	None	None	Yes	
Forebay cap. ac.ft.	12.5	None	.....	
Penstock:				
Type	Single pipe Riv. steel	Single pipe Riv. steel	Double pipe Riveted	Welded
Length, ft.	1567	355	448	952
Dia., thickness.	10′x$\frac{11}{16}$″—8′x$\frac{1}{2}$′	10′x$\frac{1}{2}$″—8′x$\frac{1}{2}$″	10′9″x$\frac{13}{16}$″ 9′9″x$\frac{1}{2}$″	9′9″x$\frac{1}{2}$″ 8′0″x$\frac{11}{16}$″
Number units.	1	1	2	
Type wheel.	Vert. turbine	Vert. turbine	Vert. turbine	
Mfg. by	Wellman-Seaver Morgan	Wellman-Seaver-Morgan	Allis-Chalmers	
Capy., hp.	15,000	15,000	40,000	
Generator mfgs.	G.E.Co.	G.E.Co.	Allis-Chalmers	
Capy., kva.	12,500	12,500	35,000	
R.p.m.	225	225	257	
Voltage	6,600	6,600	11,000	
Exciter type.	Sep. impulse wheel	Sep. impulse wheel	Direct conn.	

Up to the middle of August headquarters for construction operations was at Hat Creek No. 1, but with the completion of the two plants in that vicinity headquarters was moved to Pit River No. 1 about 10 miles northeast of the Hat Creek work. On Aug. 15 about

50 per cent of the 100,000 cu. yd. excavation in the approach-cut on Pit River No. 1 tunnel had been completed. About 25 per cent of the 100,000 cu.yd. excavation in Pit River No. 1 power house and tailrace also had been finished. The tunnel for the Pit River No. 1 plant is to be 10,111 ft. long and is being driven by the heading-bench method working from two headings. On this tunnel 5,911 ft. had been completed on Aug. 10 and the remainder was scheduled for completion by Feb. 1, 1922. The diameter of this tunnel is 14 ft. and it will be entirely lined with concrete. Where the formation traversed is poor, the section will be circular and reinforcing will be used. Otherwise, an unreinforced horseshoe section is specified.

Power for construction purposes was developed in a temporary plan near the junction of Fall and Pit Rivers, about 10 miles from Hat Creek No. 1 and 3 miles from Pit River No. 1. Here the head and flow available were suited to an old 1,000-hp. unit which the company had in a generating station at Folsom. This unit was accordingly "loaned" to the Pit River project until the first plants there should be in service.

The Pit River project is being carried out by the Pacific Gas & Electric Co., of San Francisco. O. W Peterson construction engineer for the company is in charge of work on the Pit River projects. E. H. Steele is engineer in charge of line construction.

Putting Large Bascule in Service

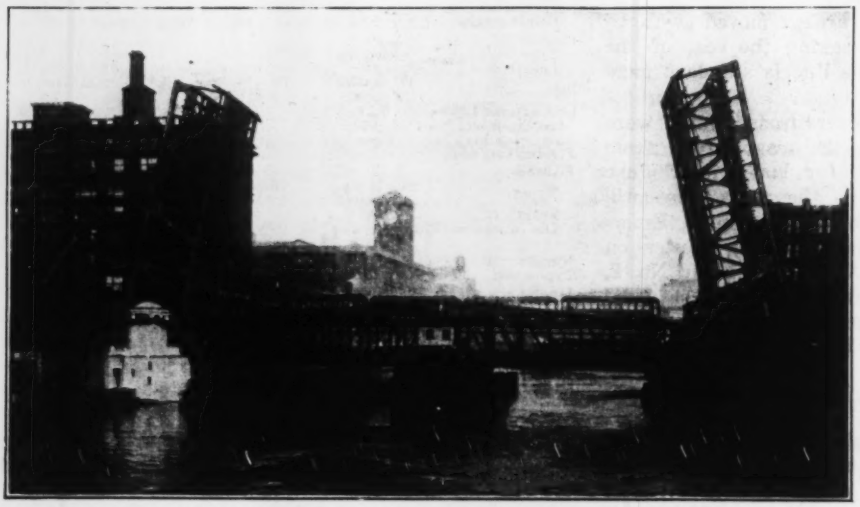
Program for Change to New Structure Involves Minimum Stoppage of Street and Elevated Railway Traffic

RAPID replacement of an old 220-ft. double-deck swing span by a double-leaf double-deck bascule span, 268 ft. c. to c. of trunnions, is planned for the Wells St. crossing of the Chicago River. The new structure, now nearly completed, will be the third double-deck bascule bridge built across the river by the city of Chicago, and will be the second carrying an elevated railway on the upper deck. For similar replacement at the Lake St. bridge in 1916, traffic on the street deck was diverted during the construction period, and that of the elevated railway was interrupted for six days (see *Engineering News*, April 20, 1916, p. 756). In view of the inconvenience to the public during the Lake St. work and in view also of the greater importance of Wells St. as a traffic thoroughfare, the work was so planned by T. G. Pihlfeldt, engineer of bridges, that both decks of the bridge have been kept open throughout the entire construction period and it is proposed to interrupt the elevated railway traffic for only 48 hours while putting the new span into service. The present condition of the work is shown in the accompanying view.

In order to maintain traffic on the street or lower deck during construction, it was necessary to provide temporary supports for the roadway and sidewalks on the approaches to the old bridge to permit of building the new substructure. For this purpose steel girders and trusses were provided and the floor loads were carried by them to pile clusters outside of the limits of the new work. The construction of the greater part of the cofferdams could then be accomplished without disturbing the old bridge. During the remodeling of the lower deck on the fixed part, the street was closed to vehicular traffic only, one roadway at a time, with but slight inconvenience to the public.

For driving those portions of the cofferdams directly under the swing bridge, traffic was stopped between 1 and 4:45 a.m. for about two weeks for each cofferdam, the span being swung to the open position during that time. The completion of the cofferdam was followed by the excavation and concreting of the counterweight pits and sub-piers. In this work the north pier was begun first and its sub-piers were completed in 1918. The main piers and counterweight pit were finished in April, 1919, and the north abutment in May, 1919. The permanent longitudinal and cross-girders for supporting the new bridge superstructure were then placed and the entire north substructure work was completed in July, 1919. Excavation for the south substructure was begun in December, 1919, and the permanent new steel girders were placed in October, 1920.

To avoid interference with traffic during erection of the bridge superstructure, with the leaves in the open or upright position, it was necessary to omit a part of the upper and lower deck floor beams, stringers and bracing, so that vehicles and elevated-railway trains could pass through the structure. When the work on the superstructure has progressed as far as possible in the raised position, it will be necessary to stop all traffic long enough to swing the old bridge to its open position, block it up on the pier protection and remove the portion over the center pier by burning or cutting the members, to afford clearance for lowering the new bridge. While this is being done, the steel floor system and bracing of the new bridge can be completed and tracks installed on the upper deck.



NEW AND OLD DOUBLE-DECK BRIDGES OVER CHICAGO RIVER AT WELLS ST.

To minimize the interruption to elevated railway and

street traffic a program was laid out covering the different steps. The first step was to close the lower deck to traffic, on Sept. 28, and it is planned to have the lower deck approaches completed by Nov. 9. Alterations to the elevated structure on the approaches will necessitate discontinuing the railway traffic temporarily, but this work can be performed on three successive Sundays, Nov. 6, 13, and 20. The leaves of the new bridge should be ready to lower to a horizontal position six days later, or on Saturday, Nov. 26. During the lowering and adjusting of the leaves, elevated traffic over the bridge will be discontinued for a period of only about 48 hours, and the new bridge should be available for use by trains on Monday morning, Nov. 28. When the leaves have been lowered, work on the lower-deck roadway of the bridge proper can be started. Final completion of the bridge and approaches should be effected by Dec. 27. Pedestrian traffic will be maintained with the least possible interruption during the period that the bridge and approaches are closed to vehicle traffic. Dredging and clearing of the channel will be done between Dec. 5 and Feb. 4.

Specifications of New Bascule

The new bridge is of the trunnion bascule type, with a span of 268 ft. c. to c. of trunnions, giving a clear channel 200 ft. wide. It has two lines of trusses spaced 41 ft. c. to c., the lower deck having a 38-ft. roadway and two 13-ft. walks (outside). On the upper deck are two tracks for the elevated railway. The total weight of each leaf complete will be about 2,460 tons, including 1,300 tons of counterweight. The deck arrangements are similar to those of the Lake St. bridge. In the Michigan Ave. bridge (*Engineering News-Record*, Sept. 9, 1920, p. 508) there are four trusses with two roadways and inside walks on the lower deck, and two wider roadways and outside walks on the upper deck. The old Wells St. swing bridge, with a length of 220 ft., was built in 1888 as a street bridge, being reinforced in 1896 to permit of carrying the elevated railway.

This important bridge was designed in the bureau of engineering of the Chicago department of public works, under the direction of Alex. Murdoch, city engineer; Charles F. Healey, assistant city engineer; Thos. G. Pihlfeldt, engineer of bridges. The construction work is under Clarence S. Rowe, engineer of bridge construction, and F. A. Berry, engineer in local charge. The principal contractors were the FitzSimons & Connell Dredge & Dock Co., substructure; Ketler-Elliot Co., superstructure and operators' houses, the steel being fabricated by the Fort Pitt Bridge Co. under sub-contract; Norwood-Noonan Co., electrical equipment. The bridge is built under license from the Strauss Bascule Bridge Co. as it embodies features patented by that concern.

House Fly Journeys Five to Six Miles a Day

Experiments conducted by the Bureau of Entomology, U. S. Department of Agriculture, show that the house fly journeys 5 to 6 miles in 24 hours and in one observed instance traveled 13.14 miles in that time. This and other species of flies, totaling 234,000 of all kinds, were dusted with red chalk in Texas, liberated, and recaptured in traps placed at various distances.

Texas County Tries Lump-Sum-Fee Road Contract

Straight Contract Prices Cut 40 per Cent—Actual Cost Runs Under Price Bid—Excellent Average Speed Maintained

HIGH prices bid in 1920 on 45 miles of concrete road, a portion of a 110-mile system planned for Wichita County, Texas, resulted in a contract being made by which the contractor receives a lump-sum fee based on a cost estimate prepared by himself. The county purchases the materials and assumes all risks, but the equipment is purchased and paid for by the contractor. With 7 miles of road completed in 1920 and 27 miles more under construction this year, the special contract is considered a success. The plant is high class, the cost is materially less than the original prices bid, and the speed of construction has been greater than the average for similar operations.

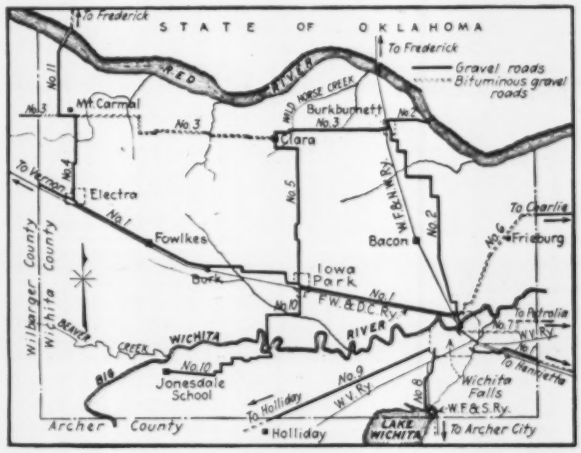


FIG. 1. MAP OF IMPROVED ROAD SYSTEM FOR WICHITA COUNTY, TEXAS

Paved roads were required by the oil-field development. A bond issue of $2,250,000 was voted and 45 miles of concrete road were planned for immediate construction. Commercial production of concrete aggregates had not been developed, so the first act of the county was to assist financially in establishing a stone-crushing plant costing $300,000. The county advanced $100,000 on a stone contract.

Bids for construction were received in January, 1920. There was one bid and it averaged $80,000 a mile. It was rejected and new bids were asked. This time the county itself put in a bid of $50,000 a mile and another bid was received from the contractor who had previously bid, but his price had been cut to $60,000 a mile. The county commissioners' court awarded the contract to the county.

In explanation of the high prices it is to be noted that the time was early in 1920 during the peak of the oil boom in Wichita County. There was a serious railroad congestion, an acute labor shortage and a heavy constant traffic to be handled by diversion from the roads under construction.

Being without equipment or organization for construction, the county engineer decided to sublet the contract. General contractors were asked to submit

FIG. 2. PLAN OF CENTRAL PROPORTIONING PLANT

bids on their own basis, with the understanding that price alone would not be regarded a reason for giving the contract but ability and reputation would be given careful consideration. A number of proposals were received, the majority being some form of cost-plus-percentage contract. All cost-plus-percentage propositions were eliminated at once as undesirable. Of the other proposals, one by Potts & Prentice, Waco, Tex., general contractors, was considered most favorably.

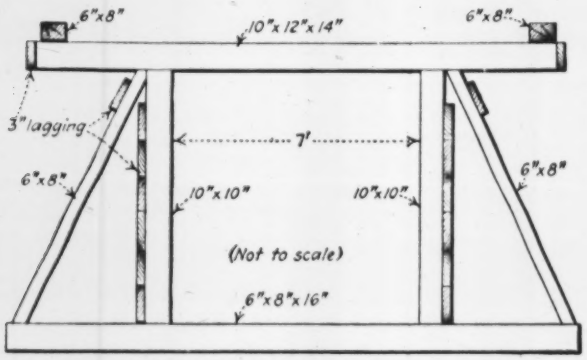


FIG. 3. BENT FOR ABOVE-GROUND TUNNEL

After careful analysis of the conditions, Potts & Prentice prepared a detailed estimate of what it would cost to do the work without bond, the county assuming all risks. On the basis of this estimate which amounted to approximately $45,000 a mile, including a lump-sum fee, the contractors agreed to undertake the work. The essential provisions of the contract were:

1. The contractors agreed to complete 44.4 miles of concrete road at an estimated cost, based upon unit prices and estimated quantities.

2. The contractors were to furnish the construction plant, which would include designated equipment of a character and quality which would insure proper construction and the completion of the project within an estimated time.

3. For the use of the equipment, the contractors were to be paid a designated rental and depreciation within the time estimated for completion. The contractors were also to be paid a portion of their lump-sum fee on monthly estimates.

This form of contract has justified itself. The county was able to begin construction at the height of the local oil boom when contractors would not assume the risks arising from the congestion of railroad traffic, uncertain materials supply and shortage of labor. The county was also able to select a contractor upon considerations not limited entirely to unit prices; it could take into account his experience, integrity and ability satisfactorily to complete the project in the estimated time. With the stabilizing of local conditions and the general decrease of material and labor costs, the savings thus accomplished have returned directly to the county.

Road improvement as planned for Wichita County, as indicated by Fig. 1, includes the 45 miles of concrete road originally contracted, and some 65 miles of concrete road yet to be constructed. The high type of pavement for the main highway was felt to be warranted by the traffic. This traffic, Wichita County being the center of the largest oil producing section of the southwest, consists largely of motor trucks hauling casing and other heavy supplies for the oil wells. A substantial section was, therefore, adopted. All the pavement is 18 ft. wide. The slabs are built in two thicknesses, 7 in. at the side and 8½ in. at the center, and 6 in. at the sides and 7½ in. at the center, depending upon the location as related to traffic and upon the condition of the subgrade. The pavement is reinforced with steel fabric weighing 28 lb. per square (100 sq.ft.) over all poor subgrade. The concrete is a 1:2:3 crushed stone mix.

With 45 miles of construction, the contractors installed a $142,000 plant, providing for central proportioning and industrial railway haulage. It consists of one standard-gage locomotive crane with a 50-ft. boom and a clamshell bucket; five trains each consisting of a 6-ton gasoline locomotive and 10 cars, each car carrying two batch boxes containing cement, sand and stone compartments; one extra locomotive for emergency purposes; four double-truck platform cars for transporting track, forms, water pipe, reinforcing mesh, tools, fuel and all miscellaneous hauling; 6½ miles of 24-in. gage, 20-lb. rail, steel tie track with slip joint ties and a full assortment of curves and switches; two number 14-E paving mixers with boom and bucket and batch transfer; two finishing machines; two subgraders; two scarifiers; two 10-ton gasoline road rollers; enough steel side forms for three days' run at each mixer; two double-unit gasoline driven pumps each with a capacity of 3,600 gal. per hour.

In 1920 owing to delays in securing materials by railway, and time consumed in installing the plant, concrete laying was not begun until October. The Wichita Falls-Lake road, 5 miles long, was completed about the end of December. Then the plant was installed on the Wichita Falls-Iowa Park-Electra road about 27½ miles long, now under construction. The plant arrangement and construction methods described refer to the present year's work.

In general, the plan is to build 10 miles from one location of the proportioning plant and then move the plant into the middle of the next 10-mile section. Fig. 2 is the plant arrangement at the first setup for 1921. Two paving outfits are operated, one working from and one working toward the plant so as to maintain a balanced haul. Track is taken up back of the paver working toward the plant and carried forward and laid in front of the paver working away from the plant As indicated, the stone and sand, unloaded from railway cars by a locomotive crane, are piled over above-ground tunnels 130 ft. long. The sketch, Fig. 3, indicates the tunnel construction with bents spaced 4 ft. apart. In the

top are tunnel traps for charging the batch boxes. Cement is charged from the platform of the cement house by means of the sliding hoppers shown by Fig. 5. The cement house of two 16 x 80 ft., and one 16 x 160-ft. section, holds 6,000 barrels. About 2,400 cu.yd. of aggregates can be stored over each tunnel.

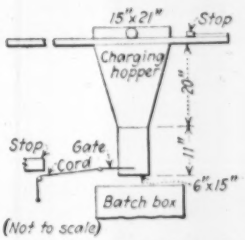


FIG. 4. DIAGRAM OF OPERATION OF LOADING HOPPER

All structures of the proportioning plant are built of sections erected by bolting so that they are knocked down and set up again without much labor or damage.

It requires five men about 12 min. to load a ten-car train (20 batches) with sand, stone and cement. The average loading time for a week, including time for replenishing gas and oil, was 17 min. and the minimum was 7 min. At the cement house the individual charging hoppers designed to reduce the time of the train in loading are a feature. They are 15 x 21 in. at the top and 6 x 15 in. at the bottom, and are about 35 in. high. The bottoms are closed by slide gates. Each hopper holds a batch and is pulled up close to the platform when being filled. When the train is in position for loading the hopper is pushed out over it as shown in Fig. 5. As the hopper is pushed out, the gate is pulled open by the cord as indicated by Fig. 4, and when the hopper is pulled back to be refilled, the gate strikes a stop and is closed. In 1½ min. six men load 70 bags of cement into a 20-batch train using 20 hoppers, which they have previously filled. The wooden hoppers illustrated have been difficult to keep tight as they weather, and it is proposed to make others of sheet iron.

Ten cars make up the average train which is pulled by a 6-ton gasoline locomotive. Each car carries two batch boxes of 25 cu.ft. capacity. Six locomotives, 52 cars and 104 boxes were purchased but only 50 cars and 5 locomotives are used to haul material, the remainder being employed in hauling forms and for replacements and moving track.

To minimize delays, switches 150 ft. long were placed approximately one mile apart, while a passing track 150 ft. long is maintained about 450 ft. in advance of each paver. The five trains are apportioned to the mixers according to the distance each mixer is from the central plant. For a ½-mile stretch, where the haul is nearly equal, one extra train alternates first to one mixer and then to the other. Train speed is about eight miles per hour empty and six miles loaded. Only one derailment has taken place on straight track. The track is laid on the shoulder of the road outside of the forms. The first laying cost $65 per mile. A foreman with four men will take up and relay one-half mile of track per day. Track maintenance requires continuously one foreman and four to six men. The locomotives burn approximately 15 gal. of gasoline per day, making six average trips of 4½ miles. The cost for labor and gasoline is 5c. to 6c. per ton-mile. Gasoline costs 18c. per gallon delivered.

The two concrete placing units are identical and include a ½ cu.yd. mixer, a subgrader, a scarifier, a 10-ton gas engine roller, a finishing and tamping machine, with belt, 900 road feet of side forms, ten canvas covers for the fresh concrete, and the necessary water lines.

The canvas covers are made in 12-ft. sections, each of which has 1 x 4-in. ribs, 20 ft. long, bowed with No. 9 wire ties, so as to make a 2-ft. rise in the center. The ends of the bows are nailed to a 2 x 6-in. longitudinal piece. A 1 x 4-in. strip spaces the bows apart at the center and helps support the six-ounce canvas.

Water was supplied first from the city mains through a 2-in. line. Later a refinery company accommodated the contractor from its water plant. Finally wells, 10 ft. square and 18 ft. deep at the material depot, were utilized. There are two double unit gas engine pumps, each pump of each unit furnishing 30 gal. per minute at 225 lb. pressure.

The gas engine on the road roller consumes 15 to 18 gal. of gasoline, steady running per eight-hour day. The 4-hp. engine on the tamper requires 5 gal. Ten 100-lb. sacks of coal are consumed by the mixer per day. The average cost of the labor per square yard of paving including all unloading and loading of material, transportation, track maintenance, form setting, subgrading, mixing and placing of concrete, finishing and curing and repairs to equipment, has averaged 30c., but for a week's time was as low as 25½c. not including overhead, rental and depreciation. In 21½ working days in April, 38,676 sq.yd. were placed. A crew of 22 men operate the proportioning plant and each mixing crew consists of 21 men.

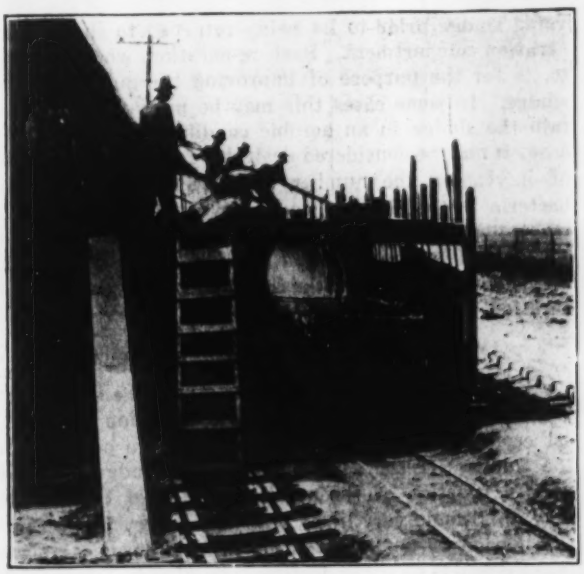


FIG. 5. CHARGING CARS WITH CEMENT BY SLIDING HOPPERS

J. M. Isbell, Wichita Falls, Texas, is county engineer in charge of the work.

Road Surfacing Costs in Manchester, England

The municipality of Manchester, England, has issued figures from its own experience showing the comparative costs and lives of various road surfacing materials:

	Cost per Sq.Yd.	Life
Imported hardwood blocks	38s. 6d.	10 years
Granite setts	37s.	20 years
Concrete, 6 or 7 in.	21s.	10 years
Artificial bituminous asphalt	19s. 6d.	10 years
Natural rock asphalt	12s. 6d.	12 to 18 years
Tar macadam	9s.	8 to 8 years

These figures are for the thoroughfares carrying the heaviest traffic of all kinds.

Aeration Period of Sludge in the Activated-Sludge Process

By Alva G. Husted
Assistant Sanitary Engineer, Department of Public Service, Cleveland, Ohio

During the past six years much experimental work has been done on the activated-sludge process of sewage treatment. The investigations which have been made range all the way from laboratory cultures of bacteria and other micro-organisms found in activated sludge and credited with much of the biological action in the treatment process to municipal treatment plants having capacities of more than 1 m.g.d. In spite of the study that has been given to the subject, there are still many features of the process concerning which little is known.

Among other subjects there is often discussed by those interested, the question of re-aeration of the activated sludge prior to its being returned to the sewage aeration compartment. Such re-aeration, when resorted to, is for the purpose of improving the quality of the sludge. In some cases this may be necessary to maintain the sludge in an aerobic condition while in other cases it may be considered desirable from the standpoint of increasing the number and activity of nitrifying bacteria in the sludge. In any event, if done at all it is because it is considered more economical to aerate the sludge separately than to give it the additional aeration in contact with the sewage in the sewage aeration tanks.

Factors Affecting Aeration Period

At first thought it appears that from the standpoint of maintaining the sludge in a good condition the greatest economy could be effected by separate aeration of the sludge. If the aeration period of sludge particles were a function of the aeration period of the sewage only, this would very likely be true. However, the aeration period of sludge particles in the sewage aeration tanks depends on other factors. To discuss this matter intelligently it will be necessary first to determine the various factors which affect the aeration period of sludge particles and the relation which they sustain to each other.

To work out a mathematical formula to determine the aeration period of sludge particles it is necessary to make certain assumptions. For the sake of simplicity it is assumed: (1) That all suspended solids in the crude sewage remain in the tank (until withdrawn as sludge) in the form of sludge particles. (2) That all dissolved solids in the crude sewage remain in solution even though changed in character by the activated-sludge process. Neither assumption is exactly true, but they are no doubt near enough the truth for the purpose of making comparisons.

Average Number of Sludge Aeration Cycles

If no sludge were returned to the inflowing sewage the aeration period of the sludge particles would be exactly equal to the aeration period of the sewage. By returning the sludge to the aeration tank inlet, however, the sludge particles are given additional aeration. The average number of cycles of aeration to which the sludge particles are subjected can be determined from the following equation:

$$N = A/S + 1 \quad \ldots\ldots\ldots\ldots (1)$$

In which N is the average number of aeration cycles to which the sludge particles are subjected; A is the quantity of suspended solids added to the sewage (by means of the returned sludge) expressed in parts of solids per million parts of sewage; and S is the quantity of suspended solids in the sewage expressed in parts per million. A/S is, therefore, the ratio of total suspended solids in the returned sludge to the total suspended solids in the sewage. The value of A in the above equation depends upon two factors: the ratio to the sewage of the sludge returned, and the moisture content of the returned sludge. It may be computed from the following equation:

$$A = 100R(100 - M) \quad \ldots\ldots\ldots\ldots (2)$$

in which R is the ratio of returned sludge to inflowing sewage expressed in per cent; and M is the moisture content of the returned sludge expressed in per cent.

Combining equations (1) and (2) we have the following equations:

$$N = \frac{100R(100 - M)}{S} + 1 \quad \ldots\ldots\ldots\ldots (3)$$

From this equation we can determine the total number (average) of aeration cycles of the sludge particles if we know the quantity of suspended matter in the sewage, the ratio of sludge return to sewage, and the moisture content of the returned sludge.

The writer has worked out the accompanying diagram for the graphical solution of equation (3). The use of

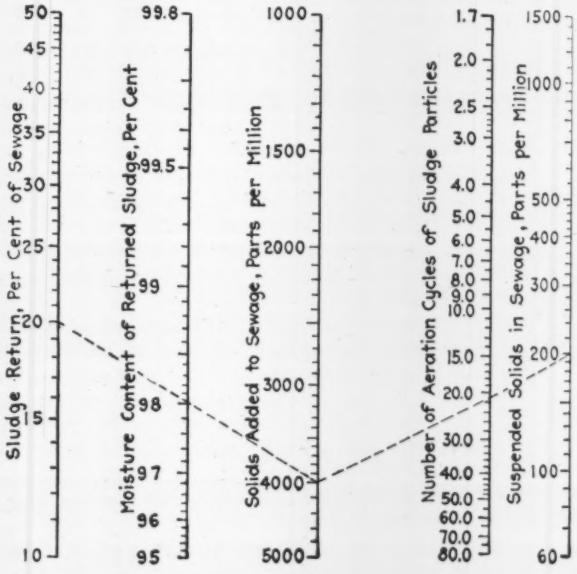


DIAGRAM FOR DETERMINING AVERAGE NUMBER OF AERATION CYCLES OF SLUDGE PARTICLES

Based on the formula, $N = \frac{100R(100 - M)}{S} + 1$

this chart is as follows: Through the values of R and M on the first and second scales draw a straight line intersecting the middle vertical scale of the chart. This gives the corresponding value of A. From this intersection draw a straight line to the value of S on the fifth vertical scale. This line intersects the fourth vertical scale at the corresponding value of N. On the chart is shown with dotted line the solution of a problem having given sludge return of 20 per cent, moisture

content of sludge of 98 per cent, and suspended solids of sewage of 200 p.p.m. The number of aeration cycles is seen to be 21.

From the foregoing discussion it is seen that the aeration period of sludge particles is a function of the suspended matter content of the sewage, of the moisture content of the returned sludge, and of the percentage of returned sludge. The operator of a plant has absolutely no control over the suspended matter content of the sewage and very little control over the moisture content of the returned sludge. He has entire control, however, over the percentage of sludge to be returned. By knowing the sewage aeration period the operator can regulate the aeration period of the sludge particles to any predetermined amount. This can be done merely by controlling the percentage of sludge returns.

It is true that an increase in the percentage of sludge return reduces the volume of aeration tank effective for sewage aeration; but the decrease in aeration period of the sewage is very small compared with the increase in aeration period of sludge particles. Stating this another way, the additional aeration tank capacity required for increasing the aeration period of sludge particles with no change in the aeration period of sewage is relatively very small.

Increased Aeration and Separate Re-Aeration

If the additional tank capacity required for increasing the aeration period of sludge particles computed in the above manner is compared with the additional tank capacity using separate re-aeration compartments it will be found that they are theoretically exactly equal. The former method is much more elastic in operation than the latter, however, and since any required aeration period of sludge particles can be obtained in a plant without separate sludge aeration tanks there does not seem to be any good reason for constructing activated-sludge plants with such sludge re-aeration tanks for improving the quality of the sludge prior to its being mixed with the inflowing sewage.

The foregoing statement is based on the assumption that the aeration of sludge particles in contact with sewage is as beneficial to the sludge as an equivalent period of aeration separately. I have no experimental data to support this contention but can see no reason why there should be any difference in the effect upon the sludge. On the other hand it does seem that from the standpoint of quality of effluent produced the advantage would probably be in favor of the larger percentage of returned sludge due to the greater number of nitrifying bacteria in contact with the sewage. The problem certainly merits serious consideration by anyone contemplating the installation of an activated-sludge plant, and particularly if there is present the opportunity for making practical tests beforehand in an experimental plant.

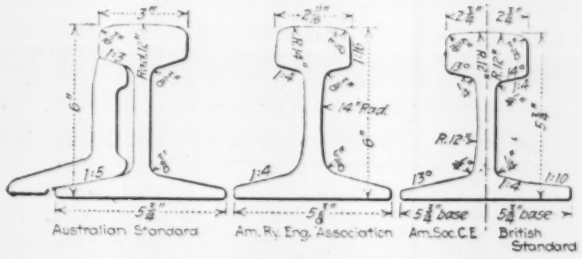
Toronto Takes Over Street Railways

The street railways of Toronto were taken over by the city on Sept. 1 and are being operated by the Toronto Transportation Commission. The price to be paid the former private owners will be determined by arbitration. Extensive track and equipment improvements are proposed.

Australian Standard Rail Sections and Specifications

Approved by Engineers, Manufacturers and State Governments—Sections Not in Accord With American Designs

THE adoption of standard rail sections and rail specifications for all the railways of the Commonwealth of Australia by the railway engineers and commissioners of the several states and by the steel manufacturers constitutes an important step in the railway and industrial development of Australia. These new standards now apply to the continental states of New South Wales, Victoria, South Australia, Queensland and Western Australia, and to the two island states of Tasmania and New Zealand, in all of which the railways are owned and operated by the governments under the direction of railway commissioners. The type of rail



COMPARISON OF AUSTRALIAN, AMERICAN AND BRITISH 100-LB. RAILS

section is at variance with American principles of rail design. The following brief history of this development is from a pamphlet issued by the Institute of Science and Industry (Commonwealth of Australia.)

Sections of rails and splice bars were decided upon at an interstate conference of railway engineers held in Melbourne in July, 1914. Drawings and specifications were approved in 1915, but owing to war conditions the approval of the railway commissioners was not obtained. In 1919 a conference, at which both the state railway engineers and the steel manufacturers were represented, was called by the Institute of Science and Industry, which was interested in railway standardization and in making Australia self-supporting as to steel products. Rail sections and specifications were adopted at a fourth engineering conference in 1920. The specifications were considered later at an interstate meeting of railway commissioners, but amendments then suggested were not acceptable to the manufacturers. An agreement was reached, however, and the specifications were approved at a conference of railway engineers and steel manufacturers, held at Sydney in April, 1921. Finally, these specifications were approved at a conference of railway commissioners.

Rail Sections

Five standard sections have been adopted, from 60 to 100 lb. per yd. A broad shallow head with round corners, a tall thin web and an exceptionally shallow base are typical features of the design. Cracks due to a thin base have been an unfavorable experience with the sections of the American Society of Civil Engineers, but the Australian sections have an even thinner base

An unusual feature is that different fishing angles are used for the top and bottom fishing surfaces. The very marked difference between the Australian and American Railway Engineering Association section is shown in Fig. 1, which gives also the Am. Soc. C. E. and British standard sections. A comparison of these four types of rail sections is given also in Table I.

TABLE I. COMPARISON OF 100-LB. RAIL SECTIONS

	Australian Standard	American A.R.E.A.	American A.S.C.E.	British Standard
Height, in.	6	6	5⅞	5⅞
Width of base, in.	5¼	5⅛	5⅛	5⅛
Width of head, in.	3	2 13/16	2⅞	2⅞
Side of head: slope	Vert.	1 to 16	Vert.	Vert.
Depth of head, in.	1 3/16	1 3/16	1 3/16	1 3/16
Depth of web, in.	3 3/16	3 3/16	3 3/16	3
Depth of base, in.	1 3/16	1 1/16	1 1/16	1 1/16
Web thickness, in.	7/16	7/16	7/16	7/16
Radius of head, in.	12	14	12	12
Radius: top corners, in.	1/16	1/8	1/16	1/8
Radius: bott. corners, in.	1/16	1/16	1/16	1/16
Radius: top fillets, in.	1/8	1/8	1/8	1/8
Radius: bott. fillets, in.	1/8	1/8	1/8	1/8
Radius: top edge base, in.	1/16	1/16	1/16	1/16
Radius: bott. edge base, in.	1/16	1/16	1/16	Sharp
Radius: sides of web, in.	Vert.	14	12	Vert.
Fishing angles: top	1:3	1:4	1:3	1:4
Fishing angles: bottom	1:5	1:4	1:3	1:4 + 1:10
Metal in head, per cent	....	38.2	42	45
Metal in web, per cent	....	22.6	21	19
Metal in base, per cent	....	39.2	37	36

Four grades of steel are included in the Australian specifications: Ordinary basic open hearth and acid bessemer steel and high-silicon basic open hearth and acid bessemer steel, the last two being made by the process of the late C. P. Sandberg. From the chemical compositions as given in Table II it will be noted that for ordinary steel the carbon content varies with the weight, while for the high-silicon steel it is uniform.

TABLE II. COMPARISON OF CHEMICAL COMPOSITION OF RAILS

	Carbon per cent	Manganese, per cent	Silicon per cent	Phosphorus, per cent (Max.)	Sulphur, per cent (Max.)
1. *Australian*	.....	.....	.....	....	....
O-H, 60-lb.	0.46–0.59	0.6–0.9	0.10 min.	0.04	0.07
O-H, 100-lb.	0.62–0.75				
Bess., 60-lb.	0.42–0.52	0.6–0.9	0.10 min.	0.07	0.07
Bess., 100 lb.	0.60–0.70				
O-H., high sil.	0.50–0.65	1.0 max.	0.2–0.4	0.06	0.06
Bess., high sil.	0.40–0.55	0.7–1.0	0.3–0.5	0.07	0.07
2. *Am. Ry. Eng. Assn.*	.....	.....	.....	....	....
O-H., 85 to 110-lb.	0.45–0.55	0.8–1.1	0.1 min.	0.10	Not spec.
Bess., 85 and over	0.62–0.77	0.6–0.9	0.1 min.	0.04	Not spec.
3. *British*	0.35–0.50	0.7–1.0	0.1 max.	0.07	0.07

For the ordinary steel, a minimum silicon content is specified, instead of the usual maximum content. It is provided that the carbon may be increased 0.02 per cent above the limits specified, on condition that for each 0.01 per cent increase in carbon the phosphorus will be reduced 0.005 per cent below the specified limit. Further, it is desired that the carbon percentage shall average as high as the mean percentage between the upper and lower limits specified. A summary of the specifications is given below.

Ingots are to be kept in vertical position until ready to be rolled or until the metal in the interior has had time to solidify. Sufficient material must be discarded from the top of the ingot to insure sound rails. In section, a variation of 1/64-in. less or 1/32-in. greater than the specified height and 1/16-in. in width of base will be permitted, but no variation will be permitted in the inclination of the fishing surfaces.

Cold straightening must be minimized and rails will be liable to rejection if the gag leaves its impression on the head or base. Rails must be straightened at such a temperature as will permit of their being handled with bare hands. In the straightening presses, the distance between supports must not be less than 36 in., except when it is necessary to straighten the rail within 36 in. of the end. In rolling, a variation from 0.5 per cent under to 1 per cent over the calculated weight will be permitted; but only this latter weight will be paid for. The calculated weights per yard of the normal sections, without bolt holes, are 60.22 lb., 70.14 lb., 80.30 lb., 90.38 lb. and 100.48 lb.

Rail Tests—From each ingot a piece of rail not less than 4 ft. or more than 5 ft. long shall be cut from the first portion of the rail. This will be placed head uppermost upon supports 3½ ft. apart, the upper surfaces of the supports being curved to a 3-in. radius. The test will comprise one blow delivered midway between the supports by an iron block weighing 2,240 lb. and having its face curved to 3-in. radius. The height of drop to be 17, 19, 20, 21½ and 22½ ft. for the five sections of 60 to 100 lb. respectively.

If the test piece fails, the first rail will be rejected and an additional test made on a piece cut from the last rolled portion of the first rail. If this piece fulfills the requirements the remaining rails from the ingot will be accepted. Should the second piece fail, another piece cut from the last rolled portion of the second rail shall be tested, and so on until each rail of the ingot has been tested. The temperature of the test pieces is to be between 60 and 100 deg. F. When the impact test indicates, in the opinion of the inspecting engineer, that the rails are too soft or too hard, he shall inform the contractor, who will direct such variation in the chemical composition, within the prescribed limits, as will improve the steel so as to obtain the desired results.

For tensile test, from any selected rail cut a test piece from as near the top of the head as possible. This will be machined parallel for a length of 2¼ in. with a length of 2 in. between gage points, and turned to a diameter of 0.564 in. This will be tested to destruction and the results recorded. [No tensile strength is specified.—EDITOR.]

Six-bolt joints are used, with angle splice bars (see drawing) having a uniform length of 30 in. and a bolt spacing of 5 in., with 1-in. bolts for 100- and 90-lb. rails, ⅞-in. for 80 lb. and ¾-in. for the others. For 1-in. bolts, the bolt holes are 1 1/16 x 1 5/16 in. for the splice bars and 1¼ in. in diameter for the rails. All the bars are slotted for spikes, but they are kept clear of any bearing on the ties, as shown. The calculated weights per pair of splice bars are from 59.75 lb. for the 60-lb. rail to 96.90 lb. for the 100-lb. rails.

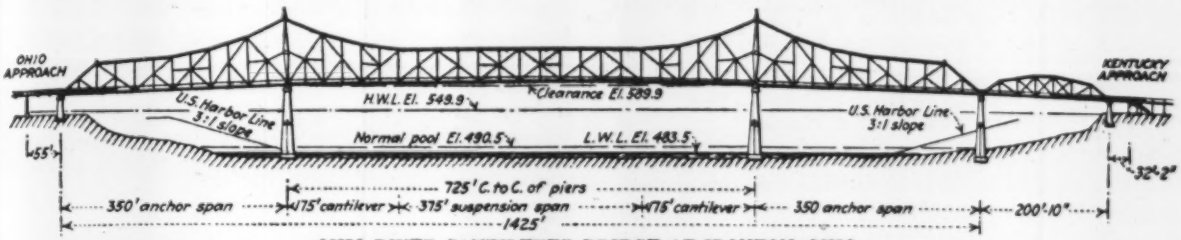
Splice bars are to be made from basic open hearth or acid bessemer steel: Carbon, 0.40 to 0.53 per cent for the former and 0.35 to 0.45 for the latter; phosphorus not to exceed 0.04 and 0.07 per cent respectively. For both kinds of steel the manganese is to be 0.55 to 0.85 per cent; silicon not less than 0.05, and sulphur not exceeding 0.70. Carbon may be increased in proportion to decrease of phosphorus, as already noted in the rail specifications. Test pieces 0.564 in. in diameter and 2¼ in. long, with a gage length of 2 in., must show an ultimate tensile strength of 80,000 to 107,000 lb. per square inch, with an elongation of not less than 15 per cent.

Track Tanks for Railway Water Supply

Although the extensive use of track tanks on English railways is commonly considered as a means of increasing the length of non-stop runs, other purposes of equal or greater importance are noted by the *Railway Gazette*, London. Thus, the track tank permits of relatively small tenders, with a reduction in weight of train. It may also enable heavy freight trains to avoid stops for water at unfavorable points, as at the foot of a long grade. In some cases the tanks are installed within 20 miles of large stations or terminals, in order to limit the use of city water which is expensive and may not be satisfactory for boiler purposes.

New Cantilever Bridge Begun on the Ohio River

A cantilever highway bridge now being built over the Ohio River from Ironton, Ohio, to Russell, Ky., will divide the present stretch of 240 miles of river between the bridges at Cincinnati and Parkersburg. The channel span will be 725 ft. c. to c. of piers, with a 375-ft. suspended span carried by 175-ft. cantilever arms, while the anchor arms will be 350 ft. long. A clear channel width of 705 ft. between piers will be provided and at the center of the span there will be a clearance of 40 ft. above high water or 99 ft. above normal pool level. This main part of the structure will consist of riveted through trusses spaced 29 ft. c. to c.



OHIO RIVER CANTILEVER BRIDGE AT IRONTON, OHIO

At Ironton, there will be an approach of plate girders on steel bents, ending with a curve and connecting with a timber trestle approximately at right angles to the bridge. At Russell, there will be a 200-ft. through truss shore span, followed by 500 ft. of steel trestle. The grades are 4 per cent and 5.36 per cent on the Ohio and Kentucky sides respectively, 4 per cent on the anchor arms, 3 per cent reducing to 1 per cent on the cantilevers, and thence 0.3 per cent to the center.

Three reinforced-concrete river piers carrying the cantilever and shore spans will have shallow foundations on sandstone rock. There will also be two piers on the banks. The structure will have a 20-ft. roadway with 6-ft. raised sidewalk. For the roadway, 3-in. shiplap oak planking will be laid diagonally on yellow pine sleepers, with concrete reinforcing and fireproofing over the railway tracks spanned by the Ironton approach. Live-load stresses were computed for the following loads on a 90-ft. length of roadway and sidewalk: two 45-ton electric cars on a 10-ft. width next the sidewalk; 30 tons on the remaining 16 ft. of width, or an 18-ton road roller anywhere.

Wind forces were figured at 350 lb. per lineal foot on the bottom laterals, and 150-lb. on the top laterals considered as a moving force. The sidewalk is inside the trusses and carries the same load as the balance of the roadway; the idea being that this roadway might be widened at some future date.

Most of the Ohio River bridges have piers built as solid rectangular blocks with either round or triangular ends. The Ironton piers have been designed similar to those for the bridge over the Mississippi River at Burlington, Iowa, built in 1917, using the I-beam cross-section (see *Engineering News*, March 8 and 22, 1917, pp. 382 and 466). The advantages are in economy of material, certain architectural effects, and placing of the mass of the concrete directly under the footings. This also gives considerable strength as against overturning.

This project originated with the Chamber of Commerce, at Ironton, Ohio, and funds were raised by public subscription under the direction of its secretary, E. B. Adams. The Ironton-Russell Bridge Co. was then incorporated in Ohio. The former town has a population of about 15,000, and Russell, Ky., with 1,500, has the shops of the Chesapeake & Ohio Ry. At present there is a ferry between the two towns. A bridge between Ironton and Ashland was commenced some years ago for an extension of the Cincinnati, Hamilton & Dayton R.R., but the project was abandoned after the substructure had been built and the river piers were afterward removed.

The bridge was designed by E. F. Barkow, assistant engineer of the Wisconsin Bridge & Iron Co., Milwaukee, Wis., under direction of Victoire Guillemin, chief engineer, and with some suggestions from J. F. Jackson as consulting engineer. The company also has the contract for both substructure and superstructure. The Dravo Constructing Co., which is building the substructure, commenced work on the foundations in July, 1921. The estimated cost is $250,000 for the substructure and $450,000 for the superstructure.

Reconstruction in France

In an article in *Engineering News-Record*, July 15, 1920, p. 101, a summary was given of French reconstruction work that had been done to April 1, 1920. Reconstruction work that has gone on in the intervening year has restored the devastated regions almost entirely. A few of the salient points in the work are reproduced herewith from statistics supplied by the Minister of Liberated Regions of France.

The population of the ten destroyed departments as of Nov. 1, 1918, was approximately 1,944,000, but by May 1, 1921, it had risen to 4,165,153, or 88 per cent of the 1914 population.

Since the armistice 2,172,167 persons have been housed in buildings either repaired or newly constructed. The distribution of these is as follows: In repaired houses, 1,573,080; in wooden huts, 253,603; in permanent structures, 82,717; in semi-permanent structures, 159,214; in temporary stone houses, 103,553.

The area of land over which the fighting took place amounted to 3,337,000 hectares. On May 1 the surface from which projectiles had been removed amounted to 2,934,128 hectares, a total of 21,370,800 tons of projectiles found in the devastated regions having been destroyed. The surface of the land from which projectiles and barbed wire nad been removed and on which all trenches had been filled was 2,787,120 hectares.

Earth used to fill trenches amounted to 239,666,481 cu.m. Of 2,164,727 hectares of land under cultivation in 1914, 1,851,039 hectares were made unfit for cultivation during the war. On the first of May, 1921, 1,754,693 hectares had been completely cleared and made fit for cultivation.

Of 52,734 km. of highway which were in a state of

complete disrepair at the time of the armistice, 43,995 km. were reconstructed by May 1, 1921. Of 3,220 bridges destroyed or damaged, 2,945 have been completely rebuilt.

Of 4,701 industrial establishments destroyed during the war, up to May 1, 3,645, or 77.5 per cent, had been reconstructed. Compared with 1914, on May 1, 1921, the personnel employed on production in these industrial establishments was 45 per cent. The total number employed in 1914 was 816,716, and the total employed in May 1, 1921, 371,337. In addition, 75,000 were employed in these industrial establishments though not on production but on reconstruction work.

Waterfront Bulkhead Construction at Two Lake Cities

Timber Round and Sheet Piling with Timber and Steel Wales and Rock Filling — For Park and Harbor Works

ROCK-FILLED pile bulkheads now under construction at Chicago and Milwaukee are representative of a type of structure used extensively in marine engineering work to form the waterfront of a dock, wharf or park, this structure serving to retain the filled or made land behind it. Different combinations of round and sheet piling are used in the Chicago work, while that at Milwaukee has only close-driven rows of round piles. In the former case also there is the unusual feature of piling driven in curved lines laid out as part of the landscape engineering for the park.

To create the new Lake Front Park, at Chicago, there will be several miles of fill extending into deep water and retained by bulkheads, with concrete retaining walls at certain points. The first work will be the filling from the present shore to a bulkhead forming what will be eventually the west side of a lagoon or protected waterway. This bulkhead, however, will be exposed to wave action and storms of the open lake until the later work is undertaken of filling for the made land between the lagoon and an outer bulkhead. The latter bulkhead will be on a harbor line established by the U. S. War Department and the type of its construction has not been decided. The filling for this park, connecting Grant Park at 12th St. with Jackson Park at 57th St., about ten miles, will require several years (see *Engineering News-Record* Aug. 21, 1919, p. 360).

Construction of the bulkhead along the west line of the future lagoon from 12th St. to 24th St. has been commenced. The structure consists essentially of two rows of close-driven round piles 18 to 20 ft. apart, with sheet piling and rock filling, as shown by Fig. 1 The work is in water 12 to 16 ft. deep and for some years it will be exposed to the open lake, as noted above. This type of construction was adopted as being best suited to the comparatively soft clay bottom and costing considerably less than a crib, stone mound or concrete-caisson bulkhead. The completed work will provide an inclosed area for the deposit of city waste and rubbish, which now averages from 750,000 to 1,000,000 cu.yd. annually. To protect the uncompleted fill, the piles are left about 5 ft. high above the water, but eventually they will be cut off at or below the water level.

The round piles are 40 to 50 ft. long, having butts not less than 12 in. in diameter. On the front row, a heavy waling timber is placed along the rear side of the piling, and a steel front wale along the outside, this being an 8-in. channel upon which the nuts of the tie rods and waling bolts take a bearing. These nuts also secure splice plates over the joints in the channels.

Sheet Piling—Triple-lap wood sheeting is applied, in different ways. In Section 1 (see Fig. 1) this sheeting is placed against two lines of waling timbers along the rear or land side of the inner row of piles. These piles will carry the toe of a future concrete retaining wall 20 ft. high, the earth filling being deposited against the sheeting and wall. The rock-fill bulkhead, with top 5 ft. above water, will protect this wall from the force of the waves. In Section 2, a part of the bulkhead will be

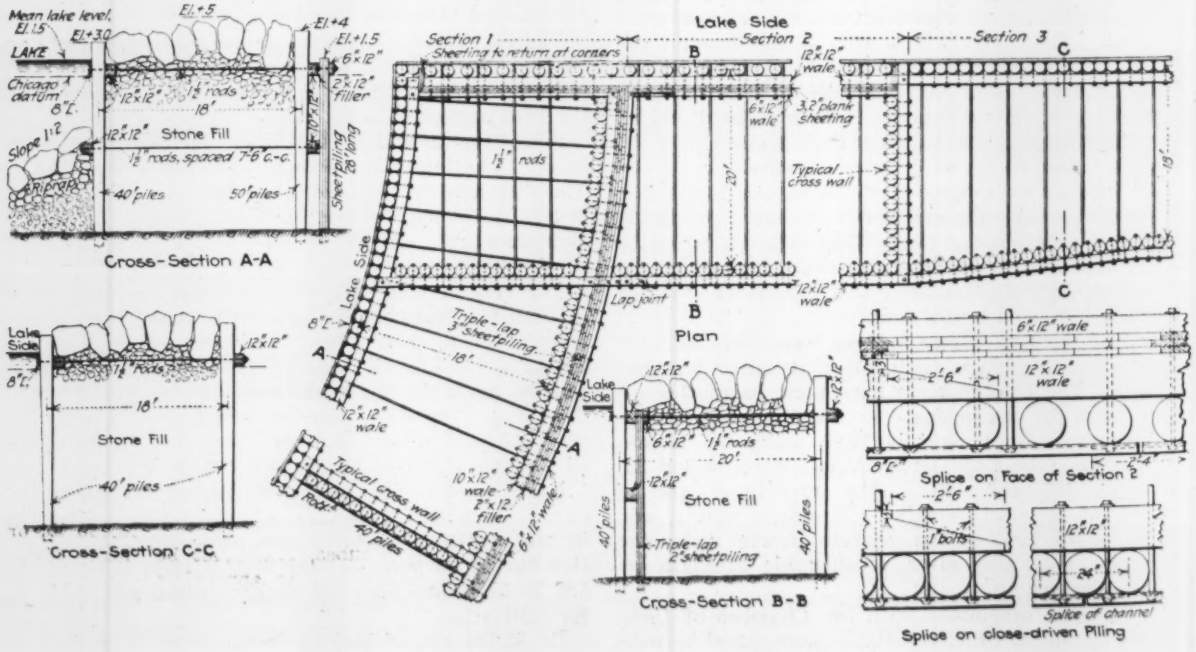


FIG. 2. BULKHEAD FOR HARBOR AT MILWAUKEE

capped with concrete paving 3 ft. above the water, to form a landing wharf or dock. At this point the sheeting is placed inside of the outer row of round piles, these piles not being close-driven but spaced about 18 in. c. to c., while the inner or rear row is driven close. Here the rock fill will be deposited against the sheeting, with the earth fill behind the rear line of piles.

For the greater part of the work, however, the present rock-fill bulkhead will form the toe of a riprapped. or unpaved sloping bank, so that the close-driven lines of round piling will be relied upon to hold the rock and

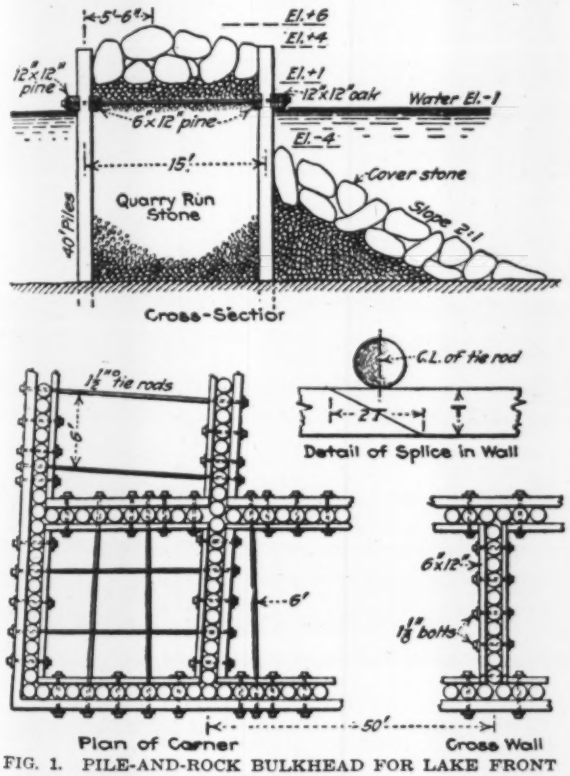


FIG. 1. PILE-AND-ROCK BULKHEAD FOR LAKE FRONT PARK, CHICAGO

the earth fill. Paving will be employed only at boat houses and landings. Pile cross-walls will be driven at intervals of about 250 ft., so that rock filling can proceed in some sections while piling is being driven for others. This construction would not be practicable if it were to be exposed permanently to the lake, as the earth slopes would soon be cut away by the waves. As a considerable part of the bulkhead will be on curved lines to conform to the outlines of the lagoons, it is provided that the thickness of the timber wales may be built up of two or more pieces in order to allow of bending them to the required curves.

Bolts and Splices—Different arrangements of bolts and tie rods are employed, as shown. In the close-spaced front piling both bolts and rods pass between the piles, except that where this piling is backed by sheeting the bolts pass through the piles, there being a bolt to every pile. In the rear row, the tie rods pass between the piles, but all bolts pass through them, each pile being bolted. Where the sheeting is on the back of the bulkhead, the tie rods pass through the main waling timber only, being placed in advance of the sheet piling. When this sheeting has been driven it is secured by a lighter waling piece bolted through each third pile. No bolts are used for the lower wales, which are held only by the tie rods.

Splices in the upper wales are cut diagonally and framed as shown, the splice being secured by through bolts. The lower wales, however, are not spliced but are lapped at least 2 ft. at the ends, alternate sections being above the others. These lower wales are held in position previous to the placing of the tie rods by means of upright sticks fitted between the two lines of wales.

Rock Fill—Limestone is specified for the bulkhead filling, the largest pieces being of 1-ton weight and the remainder graduated in size so as to practically fill all voids and make a compact mass. Not more than 5 per cent of the stone may be so small that it will pass through the crevices between the close-driven round piles. After the rock fill has settled to a permanent bearing and has been leveled up where necessary with additional material, it will be covered with a layer of limestone blocks having a minimum size of 1 cu.yd. It is expected that all this material will be taken from the old spoil banks along the rock sections of the Chicago drainage canal.

This bulkhead construction and park development has been planned under the direction of Linn White, chief engineer of the South Park Commissioners, Chicago. The Great Lakes Dredge & Dock Co., Chicago, has the contract for the present work.

Harbor Bulkhead at Milwaukee

For the waterfront of filled land at Jones Island, in connection with harbor work of the city of Milwaukee, Wis., bulkheads are used consisting of two rows of close-driven round piles with rock filling, as shown in Fig. 2. The width varies from 7 to 15 ft. according to the depth of water. Piles 20 to 45 ft. long are cut off at 4 ft. above city datum or approximately 5 ft. above mean water level. If openings occur wide enough for the escape of the stone filling, they are to be closed by piles driven on the inside. At the water line are 12 x 12-in. oak wales on the outside and 6 x 12-in. pine or fir wales on the inside, with bolts through alternate piles and threaded tie rods 6 ft. apart. The wales are in lengths of not less than 12 ft., with splices cut diagonally and bolted through the piles.

Quarry-run stone is filled in to about 2 ft. above the water and covered with blocks having a minimum weight of 2 tons and a minimum average weight of 3 tons each. On the lake side is riprap of quarry-run stone deposited along the foot of the bulkhead and covered with blocks of 3 tons minimum weight. This cover has a minimum thickness of 4 ft. at right angles to the surfaced slope of 1 on 2. Cross-walls at 50 ft. intervals consists of close-driven piles with 6 x 12-in. wales on each side at the water line. At corners, each inner line of piles is continued through to the outer line, forming a closed rectangular chamber with tie rods in both directions. Test piles 60 to 90 ft. long were driven at a few points along the bulkhead line in order to ascertain the conditions to be expected for future foundations of harbor structures.

No particular kind of stone is specified for the filling, but it must have a crushing strength of 18,000 lb. or more on 2-in. test cubes, and must be "hard, close-grained, angular quarry stone, approximately cubical in shape, and of durable quality that will not disintegrate." The quarry-run stone is to vary in general from 4-in.

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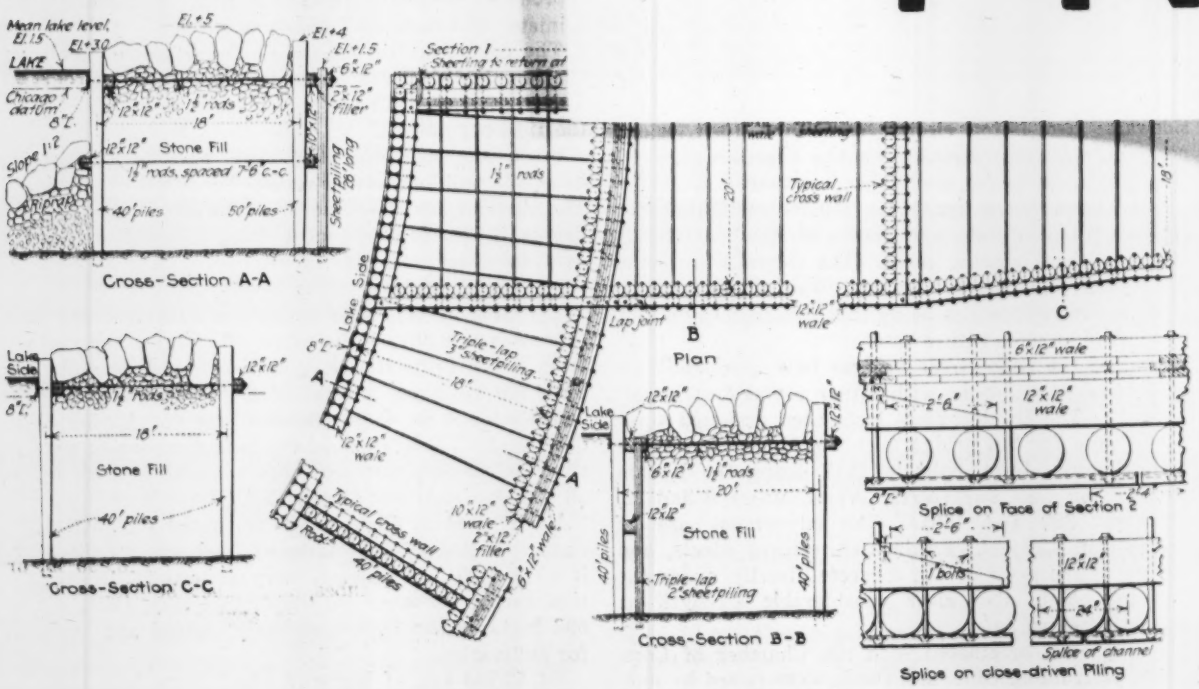

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capped with concrete paving 3 ft. above the water, to form a landing wharf or dock. At this point the sheeting is placed inside of the outer row of round piles, these piles not being close-driven but spaced about 18 in. c. to c., while the inner or rear row is driven close. Here the rock fill will be deposited against the sheeting, with the earth fill behind the rear line of piles.

For the greater part of the work, however, the present rock-fill bulkhead will form the toe of a riprapped. or unpaved sloping bank, so that the close-driven lines of round piling will be relied upon to hold the rock and

houses and landings. Pile cross-walls will be driven at intervals of about 250 ft., so that rock filling can proceed in some sections while piling is being driven for others. This construction would not be practicable if it were to be exposed permanently to the lake, as the earth slopes would soon be cut away by the waves. As a considerable part of the bulkhead will be on curved lines to conform to the outlines of the lagoons, it is provided that the thickness of the timber wales may be built up of two or more pieces in order to allow of bending them to the required curves.

Bolts and Splices—Different arrangements of bolts and tie rods are employed, as shown. In the close-spaced front piling both bolts and rods pass between the piles, except that where this piling is backed by sheeting the bolts pass through the piles, there being a bolt to every pile. In the rear row, the tie rods pass between the piles, but all bolts pass through them, each pile being bolted. Where the sheeting is on the back of the bulkhead, the tie rods pass through the main waling timber only, being placed in advance of the sheet piling. When this sheeting has been driven it is secured by a lighter waling piece bolted through each third pile. No bolts are used for the lower wales, which are held only by the tie rods.

Splices in the upper wales are cut diagonally and framed as shown, the splice being secured by through bolts. The lower wales, however, are not spliced but are lapped at least 2 ft. at the ends, alternate sections being above the others. These lower wales are held in position previous to the placing of the tie rods by means of upright sticks fitted between the two lines of wales.

Rock Fill—Limestone is specified for the bulkhead filling, the largest pieces being of 1-ton weight and the remainder graduated in size so as to practically fill all voids and make a compact mass. Not more than 5 per cent of the stone may be so small that it will pass [illegible] the crevices between the close-driven round [illegible]fter the rock fill has settled to a permanent [illegible]nd has been leveled up where necessary with [illegible] material, it will be covered with a layer of [illegible] blocks having a minimum size of 1 cu.yd. It [illegible]d that all this material will be taken from the [illegible]anks along the rock sections of the Chicago [illegible]anal.

[illegible]lkhead construction and park development has [illegible]ned under the direction of Linn White, chief [illegible]of the South Park Commissioners, Chicago. [illegible] Lakes Dredge & Dock Co., Chicago, has the [illegible]or the present work.

Harbor Bulkhead at Milwaukee

[illegible] waterfront of filled land at Jones Island, in [illegible] with harbor work of the city of Milwaukee, [illegible]heads are used consisting of two rows of [illegible]n round piles with rock filling, as shown in [illegible]he width varies from 7 to 15 ft. according to [illegible]f water. Piles 20 to 45 ft. long are cut off at [illegible]e city datum or approximately 5 ft. above [illegible]r level. If openings occur wide enough for [illegible] of the stone filling, they are to be closed [illegible]riven on the inside. At the water line are [illegible] oak wales on the outside and 6 x 12-in. pine [illegible]s on the inside, with bolts through alternate [illegible]threaded tie rods 6 ft. apart. The wales are [illegible] of not less than 12 ft., with splices cut [illegible] and bolted through the piles.

Quarry-run stone is filled in to about 2 ft. above the water and covered with blocks having a minimum weight of 2 tons and a minimum average weight of 3 tons each. On the lake side is riprap of quarry-run stone deposited along the foot of the bulkhead and covered with blocks of 3 tons minimum weight. This cover has a minimum thickness of 4 ft. at right angles to the surfaced slope of 1 on 2. Cross-walls at 50 ft. intervals consists of close-driven piles with 6 x 12-in. wales on each side at the water line. At corners, each inner line of piles is continued through to the outer line, forming a closed rectangular chamber with tie rods in both directions. Test piles 60 to 90 ft. long were driven at a few points along the bulkhead line in order to ascertain the conditions to be expected for future foundations of harbor structures.

No particular kind of stone is specified for the filling, [illegible]ut it must have a crushing strength of 18,000 lb. or more on 2-in. test cubes, and must be "hard, close-grained, angular quarry stone, approximately cubical in shape, and of durable quality that will not disintegrate." The quarry-run stone is to vary in general from 4-in.

to 2-ton blocks. A limited amount of smaller stone is permitted, provided that stone of less than 4-in. size does not constitute more than 10 per cent of the total quarry-run material, and that stone from dust to ¼-in. does not exceed 5 per cent of the total in any shipment. The stone is dumped from scows along the lake side of the piling and a dipper dredge then places it in the bulkhead. Hydraulic dredging will be employed for filling behind the bulkhead, under a contract which calls for 430,000 cu.yd. of material to be dredged from the Kinnickinnic River and filled in to about 5 ft. above city datum.

This work is being done for the Board of Harbor Commissioners, Milwaukee, Wis., and is in charge of F. A. Kaiser, senior engineer. The Great Lakes Dredge & Dock Co., Chicago, has the contract for the bulkhead, and the Cleveland Engineering Construction Co., Cleveland, Ohio, has the contract for dredging.

New Application of Pitot Tube in Testing Pumps

Tube Extending Entirely Across Pipe Affords Advantages in Accuracy, Convenience and Economy

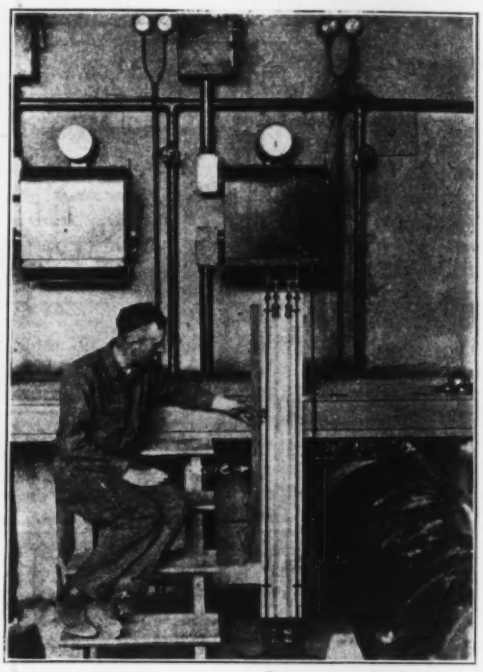
By Arthur L. Collins
Civil and Electrical Engineer, San Francisco, Cal.

A NEW application of the pitot tube principle to the measurement of flow in pipes, which has recently been developed for testing irrigation and reclamation pumping plants in California, eliminates several major disadvantages of the ordinary pitot tube methods, and, although it requires only equipment that can be assembled at low cost, can be depended upon for very accurate results in the hands of operators not specially trained in testing work.

The development of this method came about through greatly increased rates for electric power in California irrigation districts, immediately followed by a demand for pump tests and careful checks on pump efficiency. The primary conditions which had to be met were (1) a simple and inexpensive means of determining the quantity of water passing through pipes of various sizes and (2) the head against which the water is delivered. The method has a special field in pump testing because in addition to measuring volume of discharge, it can be used to determine the direction and velocity in different parts of a scroll casing. However, it is not limited to the pumping field and should prove very useful wherever data on the rate and quantity of flow in pipes are desired.

As applied to the needs of the California agricultural districts, the apparatus consists of a small diameter tube (usually ¼ to $\frac{7}{16}$ in.) that extends entirely through the pipe to be tested. The tube has a diaphragm at its center, on opposite sides of which, and facing in opposite directions, are two pitot openings through which the impact of the stream flow, whether positive or negative, registers in two manometer tubes. Thus "upstream" and "downstream" pitot readings can be taken simultaneously. The tube is made of sufficient length so that by sliding it in the packing glands at the pipe walls the pitot openings can be brought outside the pipe for inspection. Advantages of having the tube extend entirely through the pipe are that there is no vibration or unbalanced pressure due to an "overhung tube," and no danger of injury to pitot openings due to their being accidentally jammed against the far side of the pipe. The device is patented by the author of this article.

With the apparatus set up ready for testing, the tube is slowly revolved until the position giving maximum deflection in the manometer columns is noted. When this position has been found, revolving the tube another 180 deg. should reverse the high and low readings on the manometers. This constitutes a check on the accuracy of the instrument and shows at once if the openings are clogged or if air bubbles or other obstructions have lodged in the connecting tubes.



PITOT TUBE PERMANENTLY INSTALLED IN 30-IN. SUCTION PIPE OF 24-IN. CENTRIFUGAL PUMP

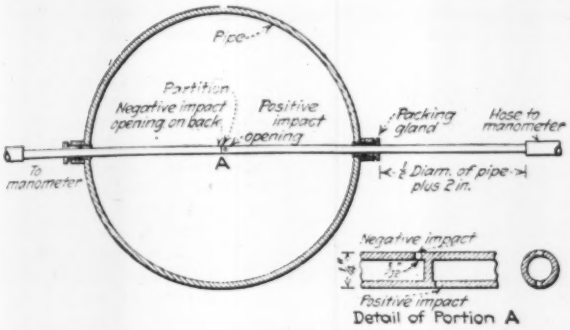
A permanent installation where the instrument is being used on a 30-in. pipe is shown in the accompanying illustration. Indicators are installed in this plant on each of five 24-in. centrifugal pumps. The capacity is about 30 sec.-ft. and the differential pressure is 30 in. of water, or each inch is 3⅓ per cent of the velocity head, amounting to about 1.6 per cent variation in capacity. An operator can read the water columns to within ⅛ in., so that this variation represents about 0.2 per cent of the capacity; that is, when the capacity of the pump varies 0.2 of one per cent the operator can detect the change.

This is believed to be the first installation of a pitot tube on a pipe so large and under vacuum where the operator can readily and accurately measure the water flowing in the pipe. With apparatus such as was heretofore ordinarily used for this purpose, such measurements have been possible only when conducted by engineers or skilled operators. An advantage of such a permanent installation is that the plant operator at once detects the fall in capacity when sticks lodge in the runner or when the efficiency of the pump is otherwise affected for any reason.

The simplicity of the equipment and methods of test described in the foregoing are such that a complete

outfit, including everything required for testing pumps of all sizes, ranging from a few inches up to 100 in., and taking power readings on motors up to 1,000 h.p., can be easily loaded into a light auto truck.

In pumping plants where the efficiency has fallen very low it is often desirable to ascertain the angle at which the water emerges from the impeller and the velocity in the shell or case, and with these data to redesign and improve the equipment to secure higher efficiency. In both these operations the final degree of accuracy with the testing device here described depends only upon the care taken by the operator. The direction of flow is determined by placing a protractor on the end of the pitot tube and then revolving it as in measuring velocity. As many as nine tubes have been used for simultaneous readings in measuring velocities in the scroll case of a 42-in. pump.



ARRANGEMENT OF TUBE IN PIPE AND DETAIL, SHOWING PITOT OPENINGS

Reclamation Service Reports on Colorado River Problem

Recommends Unbiased Board to Allocate Costs and Benefits of Power and Irrigation Development—Plan for Greatest Dam

[*Washington Correspondence*]

ALL existing data bearing directly upon the problems of the lower Colorado River have been condensed in a single report prepared by the Reclamation Service. Since the publication of a preliminary report a year ago by the Irrigation Committee of the House of Representatives, further investigations have been made by and embodied in the report, which comprises six volumes. The recommendations, which form a part of the report are as follows:

(1) That through suitable legislation the United States participate in the construction of the Boulder Canyon Reservoir and the High Line Canal from Laguna dam to the Imperial Valley, in proportion to the interests of the public lands and the Indian lands as set forth in the report.

(2) That the Secretary of the Interior be authorized to enter immediately into contracts with such states, counties, municipalities and other interests as may desire to participate in the benefits of the construction herein recommended, providing that each participating agency furnish funds with which to defray its proportionate share of the expense, as allocated by a board to be appointed.

(3) It is recommended that there be appointed a board of three competent persons who shall not be resident in any of the states affected by the decisions of the board and who shall have no financial interest in these decisions, one being an irrigation engineer, one a power engineer and one learned in irrigation law, to allocate the cost and benefits of the proposed construction and assess the cost upon those receiving the benefits in proportion to such benefits. The decisions of this board should supersede the preliminary allocation recommended in this report and contract should be entered into with all participating parties to abide by the decisions of this board and to supply funds for construction in proportion to benefits as determined by the board.

(4) That the Secretary of the Interior be authorized to proceed with the work development as rapidly as the funds are made available from any of the sources provided.

The report shows the quantity and regularity of water-supply for irrigation; data pertaining to flood control; data concerning storage facilities; information as to the amount of land available for irrigation, and the canal systems which will be required.

Boulder Dam Very Large

The report points out that since the preliminary examination was made borings have been prosecuted at the proposed dam site in Boulder Canyon and the cross-section of the canyon has been worked out fairly completely. Additional borings are necessary to develop the entire foundation of the proposed dam and it is expected that these will modify its location. Similar information is necessary for the cofferdam which must precede the main construction and must be of a substantial character. The borings indicate the maximum depth to bed-rock to be 133 ft. below the low water level. As a result it is pointed out that foundation work will be difficult and expensive.

The opinion is expressed in the report that "the investigations at Boulder Canyon have shown the feasibility of a high dam at that point. The amount of storage which would be furnished by this dam has been computed at Contour elevations ranging from 750 ft. to 1,300 ft. showing that the capacity would range from 58,750 acre-feet to 31,600,000 acre-feet. The canyon walls extend to the 2,000-ft. contour or 700 ft. higher than the contour which would result in a capacity of 31,600,000 acre-feet

The entire matter is to be taken up at a public hearing before the Secretary of the Interior in Washington on October 27. It had been hoped to conduct this hearing in San Diego on October 17 but Secretary Fall found it impossible to conduct the hearing while in the West.

Fighting Flies with Fire and Ferment

Fly breeding in horse manure in Mesopotamia is controlled in the rainy season by the destruction of maggots through the heat of fermentation of the manure on piling it in mounds 9 to 12 ft. in diameter and 20 to 25 ft. high, built up on hard ground. Maggots escaping from the surface of the mounds are trapped in shallow trenches surrounding the mounds. Except in the rainy season the manure is first sun dried by spreading it on the ground in thin layers. It is then used as the staple fuel for burning garbage, offal, etc., and latrine stuff. Details of this and other fly-prevention matters, according to *Public Health Engineering Abstracts* for Aug. 27, are given in the *Tropical Diseases Bulletin* for July 15, 1921.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Blames Inspector for Chester Accident

Sir—In your issue of Sept. 22, p. 469, you have an article entitled "Penalty of Botch Work." In this article you say, "The blame for the wholesale drowning rests solely on the man who botched the repairs." I do not agree with you. The blame rests solely on the man or men who inspected and passed such a piece of work. EDGAR PIERCY.

Elyria, Ohio, Sept. 26.

Locomotive Fuel Oil Stations

Sir—Relative to fuel oil station design of the Texas & Pacific Ry., I am attaching a print showing in detail the unloading troughs, which are different from those shown in your issue of Aug. 4, Page 154. The pipe layout as given on page 183, Fig. 1, showing double line to the elevated tank is incorrect. There is only one line between the storage and elevated tank, the oil being by-passed through the pump by valves. Sometimes a gravity flow is obtained which materially reduces our pumping cost. The oil column shown on page 186 as used by the Texas & Pacific Ry. is a specially designed oil column and not a "water column adapted to this purpose." R. L. HOLMES,

Engineer Water Supply, T. & P. Ry.

Dallas, Tex., Sept. 26.

[In the drawing sent by Mr. Holmes, the longitudinal timbers carrying the rails at the oil troughs are increased in length to 10 ft. 8 in., their ends being cut away to fit under the cross ties at the ends of the trough. These ties are bolted to the timbers. The oil column mentioned is of the Sheffield type.—Editor.]

Granite Block Paving Specifications

Sir—Your editorial comment on a recent bulletin of the U. S. Bureau of Public Roads, respecting desirable qualifications for granite paving blocks (See issue of June 30, p. 1102) gave considerable pleasure to the writer, authoritatively justifying his attitude on the subject of specifications for such material during his term of office as engineer of highways, Borough of Manhattan, New York City.

To the present chairman of the Transit Commission, the Hon. George McAneny, formerly borough president of Manhattan, belongs the credit for initiating the practice and securing the necessary appropriations to carry out on a large scale the repaving of Manhattan's heavy-traffic streets with modern-type, smooth granite block pavements. As his engineer of highways, the writer was besieged by amateur faddists and interested salesmen to specify for this work only types of granite which could meet certain extreme laboratory tests on small specimens as to hardness, crushing strength, wear and toughness. A series of tests was made on samples from all available sources for New York stone paving block material and from European streets, the results being given in the writer's annual report for 1914. These tests showed that it would have been necessary to reduce the stone paving program if we had adopted as our criterion the proposed laboratory tests. Samples from nearly all the quarries that were producing satisfactory block failed to meet the required limits, as did those from first-class streets of Europe. At the same period an inspection of the World's best stone paved streets showed that proper dressing and laying were the real desiderata, and that, as one might expect, uniform wearing quality and not extreme hardness was the prime necessity.

HENRY WELLES DURHAM,

Lima, Peru, Aug. 10. With the Foundation Co.

Curved Wall-Girder Fails When Collision Knocks Out Middle Posts

Sir—A peculiar accident took place in Springfield early in the morning of Aug. 31, of which I happened to see the result. A trolley train of three loaded freight cars left the track and struck the corner of a hotel building at State and Dwight Sts. This building is of brick with stone trim and wooden interior framing. The walls are self-supporting. The street floor of the building is occupied by stores, while the upper four floors are occupied by the hotel. The corner of the building is rounded, and the masonry walls were carried at the second-floor level by a curved girder, evidently supported at the ends and by two columns near the center. The force of the impact from the cars knocked out the center supports of the curved girder, and the girder rotated about its ends, letting down the whole corner of the building. The first two cars were absolutely destroyed by the collision and the falling masonry. Although the hotel contained a hundred guests at the time only one seems to have been injured at all and this one only slightly. The motorman was carried right into the building with his car, but was practically uninjured. A messenger in the cars was buried beneath the debris but not hurt. That all these people could escape serious injury seems incredible. W. W. BIGELOW.

CURVED GIRDER AT SECOND FLOOR FAILED

Boston, Sept. 2.

Be Sure Reinforcement Is Correctly Placed

Sir—The description of the failure of a section of roof slab at Atlantic City in your issue of Aug. 18, brings to mind a need which is realized by some engineers, but overlooked by the many. This is the need for inclusion in specifications for reinforced-concrete buildings of requirements that reinforcement be supported in the position intended for it. In other words, chairs shall be used, of such construction that steel may be held rigidly in place. These devices should be shown on shop and erection drawings in detail, that the designer may know exactly what is intended by the builder. Too often this is left to the discretion of the contractor who may or may not use steel supports as he sees fit.

The engineer, on visiting the structure he has created, is horrified at what he sees and feels that next time he will use a larger factor of safety. He sees, more often than not, reinforcing lying flat on the forms before concrete placing has commenced. Then he sees a laborer, who knows nothing at all of stresses in concrete members, lift his carefully figured steel from the forms. That is, he lifts it whenever he happens to remember to do so. The amount by which it is raised is also at the discretion of the man with the hoe. Is it not a matter for wonder that concrete failures have not been more frequent?

There is another danger in the use of mesh reinforcement when proper precautions for supporting it have not been

observed. Expanded metal and wire meshes are usually lapped at whatever points may be necessary, without regard to the location of laps in the span. Should the mesh rest on the forms, with insufficient protection underneath, there is a danger of failure through slipping at the lap because of want of bond. The steel, of whatever grade and in whatever shape, must have covering enough to develop the required bonding strength to make the lap effective. Unless this can be done by placing it in its right place in the slab, a clamp or some other form of mechanical tie must be used, or mesh reinforcement discarded altogether. The writer knows of one failure of a slab reinforced with mesh which could be explained only on such conditions, as examination revealed that the steel in the fallen slab was barely covered with concrete.

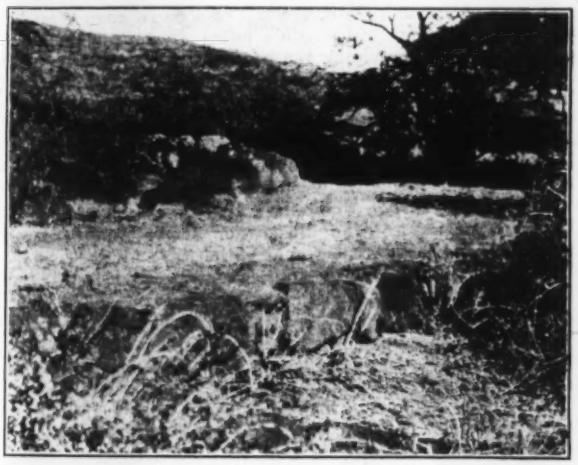
Mesh reinforcement is, pound for pound, the best to be had, but careful designers will use it with caution as long as its position is left entirely to chance. Manufacturers would do well to devise ways for holding it in place till concrete has set.

FRANK W. CHAPPELL,
Consulting Engineer.

Dallas, Texas, Sept. 2.

Old Hawaiian Trail Teaches Road Subgrade Lesson

Sir—Crossing the Koolan Mountains near Makapuu, Hawaii, between Honolulu and Waimanalo, is an old trail, the remarkable feature of which is that it is paved to a thickness of at least 1 ft. with lava rock. Since the route was constructed about 1840, before there could have been any heavy vehicle traffic, and was used principally by pack animals, a question arose as to the reason for so heavy a pavement on such a route. An examination of the soil showed that some sort of pavement was essential to keep the trail open during and after heavy tropical rains, but why adopt so costly a pavement instead of draining and laying gravel or coral-rock road?



HAWAIIAN ROAD BUILT WITH 12-IN. BASE

When the writer began his duties in Hawaii as department engineer on the staff of the commanding general in 1916, engineers believed that conditions were favorable for macadam roads, and many roads of this type were built, using both water and oil for binding purposes. The condition which demanded the heavy pavement on the old trail seems to have been lost sight of and considerable expenditures were made for new roads before it was rediscovered.

About 1915, Professor Keller, of the College of Hawaii constructed through the college grounds a test road made up of sections of the following types: Water-bound coral; Warrenite; oil-bound lava macadam in two lengths using different oils; the same with a seal coat; plain concrete; and reinforced concrete. In 1916 every section had failed with the exception of the reinforced concrete, but all were continued in service by means of repairs. The manner of failure, however, was not the same in all cases.

The simple coral roadway proved too soft to withstand the wear of motor-truck traffic. The Warrenite, softened by the tropic sun, rolled into waves and valleys and finally failed utterly. The oil macadam failed in spots wherever water penetrated to the subsoil, and even the seal coat sections failed in the same way, but after a greater lapse of time. The plain concrete cracked into large pieces which soon lost their proper positions, some settling, some heaving up, and all disrupting badly until replaced. The reinforced concrete cracked in several places, but the large pieces retained their relative positions and so long as the writer observed them (three years) were still serviceable and apparently not in need of repair.

About this time a concrete pavement in the basement of the college building nearby failed by heaving and breaking. Investigation led to the conclusion that the pressure was due to expansion of the soil caused by water. This expansion was found to be a characteristic of the soil in many parts of the island.

A concrete pavement laid by the city near the college failed likewise about three months after completion, although not subjected to heavy traffic. The cause was believed to be the same. It is possible that a uniform upheaval of a large area of pavement might not disrupt the pavement, but where the moisture affecting the subsoil is the result of percolation from the roadsides it is not to be expected that uniformity will be the rule, and the upheaval occurs in spots, with disastrous results.

With two important exceptions, the writer was unable to find any road pavement on the island not constructed of reinforced concrete which had endured as long as one year. One of the exceptions was the block on Fort St., a heavy oil-bound macadam. The other was the pavement on Beretania St., where a 2-in. bitulithic surface was laid on a 5-in. plain concrete base. In both cases the gutters, curbs, sidewalks and adjacent buildings afforded probably complete protection against percolating water from the surface and drainage against ground water.

Having become convinced that heaving was the true cause of the general failures of pavement of various kinds, the writer made several visits to the old trail near Makapuu and found that the soil there was subject to expansion and contraction to a marked extent. It would be interesting to know what was the original construction of the trail and what were its failures until its builders realized that only a massive pavement would endure under the existing conditions. The lesson had to be learned again by modern engineers. Apparently some of the oldest inhabitants were well aware of the facts, but engineers coming from the mainland assumed that since frost was not to be encountered protection against upheaval would not be necessary.

R. R. RAYMOND,
Colonel, Corps of Engineers, U. S. A., Retired.

Cambridge, N. Y., Aug. 22,.

Problems in the Chlorination of Water

Sir—I have been greatly interested in the articles in *Engineering News-Record*, Sept. 8 and 15, pp. 393 and 444, on "Problems in the Chlorination of Water." Several operators mentioned the use of ortho-tolidine as an indicator to determine the free or residual chlorine remaining after the use of chlorine. There is grave danger in making this test, since it has been found that numerous waters which have not been treated with chlorine will give a positive reaction with ortho-tolidine. While the ortho-tolidine test is very valuable, its use should be thoroughly investigated before any hard-and-fast standard is established.

When a solution of ortho-tolidine is added to a water to which chlorine has been applied, if there be any so-called "free or residual chlorine" present, a distinct yellow color will be produced within five minutes. It is necessary in most cases to have a positive reaction in order to be sure of a satisfactory bacterial reduction. The causes of this reaction cannot be removed by passing the water through quantitative filter paper. In several cases, however, it has been found that sand filtration will remove the cause, producing a water that is negative to ortho-tolidine. If water

be treated with sulphate of alumina and passed through filter paper, the ortho-tolidine will give a negative result. If chlorine is applied to raw water with sulphate of alumina before filtration, ortho-tolidine will give a positive reaction, since coagulation and filtration do not remove chlorine.

Recent tests of water from Brandywine Creek, Wilmington, Del., Susquehanna River, Harrisburg, Pa., Cadorour Creek, York, Pa., Chemung River, Elmira, N. Y., Mohawk River, Cohoes, N. Y., and Hudson River, Albany, N. Y., gave positive reactions, while the water from the Niagara River at Niagara Falls, N. Y., gave a negative reaction. All of the waters named are polluted. The water at Wilmington, Del., after passing through the slow sand filters, gave a negative result. Water from the wells at Green Island, N. Y., containing manganese and iron, gave a positive reaction. Stored surface water from Sebago Lake, Portland, Me., did not react. Water from the upper and lower service reservoirs at Troy and Kingston, N. Y., gave positive reactions.

These reactions are more noticeable during the summer months when the temperature of the water is high and algae are present in large numbers.

Operators using this test should in all cases examine the untreated as well as the treated water. If such tests are not made serious troubles are sure to arise, since unsterilized water will be delivered to consumers.

JAMES M. CAIRD,
Troy, N. Y., Sept. 15 Chemist and Bacteriologist.

Electrolysis Only In Wet Concrete

Sir—Relative to the articles on corrosion of reinforcing steel in concrete noted in your issue of Sept. 29 and other issues preceding, it may assist engineers who investigate this difficulty to realize that electrolysis from outside currents is of no moment, *provided the concrete is dry*. If the concrete is wet, electrolysis is self-engendered, even without stray currents; and chlorides or other catalyzers present assist such action materially.

But if concrete is dry, the reinforcing rods would carry up to their conducting capacity without damage, Numerous instances coming under the writer's observation have confirmed this beyond question; and it may save others a great deal of fruitless investigation if this point is borne in mind.

New York City, Sept. 30. NATHAN C. JOHNSON.

Solid vs. Pneumatic Tires for Trucks

Sir — I was greatly interested in the letter from H. W. Slauson, in your issue of July 28, p. 161, in which he makes the very definite statement that "road damage, rutting and the like, is entirely a factor of weight per square inch of road contact." Without wishing to controvert Mr. Slauson's statement or to argue in favor of pneumatic truck tires as against solid tires, I should be particularly interested to know upon what data the statement is based.

It has always seemed to me that speed of the vehicle, gradient of the road and density and smoothness of the road surface all have a very important bearing upon the life of the road under traffic. For instance, a road that has not a smooth surface is subjected to a succession of blows as each wheel falls from a higher spot to a lower spot on the surface. Of course, the potential intensity of the blow upon each square inch of road-surface would be determined by the weight per square inch of contact, but its actual destructive effect upon that surface will be greatly modified by the resilience of the tire and under such circumstances it would seem that a pneumatic tire would be less destructive than a solid tire.

Furthermore, few road-surfaces, except new concrete or sheet asphalt, are even nearly perfectly smooth; if they were, steel tires would give practically as good service as any rubber tires, and this means that unless the tires are very resilient the load will momentarily be supported upon very small areas of road-surface. This, of course, will result in much greater weights per unit of area and a much greater destructive effect upon the road. Here again the pneumatic tire would seem to have the advantage by reason of its ability to mould itself in conformity with every irregularity of the road-surface and thus maintain a constant area of road contact. While this characteristic of the pneumatic tire seems to recommend its use for front wheels which simply roll over the road surface, it is an argument against the use of pneumatic tires for rear, or driving, wheels and, I think, a better argument than the one advanced by Mr. Slauson. This very ability of the pneumatic tire to mould itself to the road aids materially in the formation of a vacuum under the tire that has a very decided tendency to tear out the finer particles from any but the most thoroughly bound road-surfaces.

Palmer, Mass., Aug. 19. CHARLES F. DINGMAN.

Hinge Action in Exterior Concrete Columns

Sir—In *Engineering News-Record*, Sept. 1, p. 348, is a description of the design used on a long span garage in New York City. This article describes certain steps taken in the construction, provided to take care of *possible* settlement of the foundations. The design, however, fails to provide for several very definite actual conditions present in this structure.

Ten years or so ago, when little had been published in America dealing with the distribution of the total moment in a concrete frame, there was some excuse for a designer to assume that the connection between a concrete beam and column was hinged, as has been done in this case. In several standard text-books now on the market this subject is treated at some length.

In this particular case the designer has used a 12 in. thick by 18 in. wide column under the end of a 66-ft. span girder. Without considering the possible effect of unequal settlement, but simply combining the bending and direct stresses actually occurring in this column, extremely high conditions of stress will be found. If the unequal settlement contemplated in this design actually does occur, a great increase in the stresses in the exterior column might result.

Near the face of the exterior column, the bond stress on the steel in the girder is within the allowable limits, but no adequate anchorage to produce this necessary bond resistance is provided. The illustration shows four girders G1 at each end which, one would gather, are all the same, while the load on two of the four is clearly much less than that on the other two. Bars 1¼ in. sq. appear to be spaced 2¼ in. on centers in the bottom of a 4 ft. deep girder, giving ⅞ in. of concrete between the sides of the bars—if this concrete actually gets there. This would appear rather inadequate to develop proper bonding of the steel and concrete.

The writer's opinion is that this design is poor from the viewpoint of economy in concrete design, but more important it is a good example of how long span concrete construction should not be designed.

W. STUART TAIT,
Chicago, Ill., Sept. 15. Civil Engineer.

[This letter has been submitted to the designer of the building in question, and he has replied as follows: Editor]

Sir—Obligingly Mr. Tait has taken the time to compute the actual bending moments in the exterior columns and combined stresses resulting from these moments with the direct loads and has found extremely high conditions of stress in those columns. Simultaneously Mr. Tait has found out that the bond stress on the steel in the girder near the face of the exterior column is within the allowable limits, but that no adequate anchorage to produce this necessary bond resistance is provided.

Evidently Mr. Tait is not aware of the fact that if there is any moment in the exterior column there must be a negative moment at the end of the girder and that the bond stress must be reckoned on the top bars, of which there is none shown in the design.

I perfectly agree with Mr. Tait that for any given condition of loading it will be a simple matter to find out the moments in any part of a concrete frame if we know the conditions of restraint at the ends and also the effective cross section at any part of the frame. Having this particular framing in mind, I confess that I did not know either

the conditions of restraint at the bottom of these exterior columns nor the actual effective cross section at any part of the girder. How Mr. Tait knew of these conditions is a great deal more than I can guess. What about the effect of pouring lines?

There can be no question about the fact that there is a certain amount of bending moment on the exterior columns of this building which must be provided for directly or indirectly. The fact that the building is completed and these exterior columns are doing their work without any sign of weakness is the best proof that they are well taken care of.

In the last three years I have designed and supervised the construction of several concrete buildings with unusually long span girders. One of the principal lessons I have learned by my experience and observation is that the pouring line at the bottom of girders resting on exterior columns can be assumed as a hinge, providing the girders are designed consistently and provided for amply. By all means the unit stresses in the exterior columns must be kept 10 to 20 per cent below allowable stresses for direct bearing, depending upon the circumstances.

New York City, Sept. 21. MISSAC THOMPSON, Consulting Engineer.

Cast-Iron and Other Materials for Water Pipe

Sir—The letter from Thos. F. Wolf in your issue of Sept. 29th, p. 538, gives the impression that my recent paper and your editorial comment were adverse to the use of cast-iron pipe. So far as I am concerned, I am thoroughly convinced that for general all around purposes cast-iron pipe is the most practicable and best article for water supply on the market today. Occasionally there are conditions that would fully warrant the substitution of wood pipe; other cases suggest wrought-iron or steel pipe; and in some other cases, concrete pipe; and in very rare cases possibly the use of vitrified clay pipe; but to every one of these installations there would probably be twenty of cast-iron pipe. Cast-iron pipe, like all other good articles, has its objections, the most serious of which is tuberculation, which, as Mr. Wolf truly says, is not universal. With many waters cast-iron pipe does not tuberculate and in these situations it is ideal for water-works purposes.

While pipe cleaning is an effective remedy for tuberculation it is seldom adopted on account of the practical difficulties and the general opinion that when once started the cleaning has to be frequently repeated, so that most water-works operators prefer to continue with the old cast-iron pipe and its greatly reduced discharging capacity.

The writer believes that there are great possibilities in the improvement of water-works pipe which will overcome the troubles of tuberculation and corrosion; these may be the result of metal cast under conditions inhibitive to rust or in the use of some other material than iron. For such a pipe the intelligent water-works owner would be willing to pay a much higher price than that for cast-iron pipe in situations where it is subject to tuberculation.

Philadelphia, Oct. 1. J. W. LEDOUX, Consulting Engineer.

A Device To Prevent Splitting Failure in Framed Timber

Sir—The article in the Sept. 29 issue by H. K. Phelps on "Splitting Failure in a Wooden Truss" is a very good example of the indifference with which minor structures and structural members are often treated. Such details as the construction of a wooden roof truss are occasionally left to the judgment of a carpenter boss, whose lifelong experience, as stated by himself, gives him the confidence to design "weak" structures.

As to the cause of failure cited by Mr. Phelps, I can but point out that were the readers of your worthy paper to take advantage of the helpful hints found therein such failures would be greatly lessened. The writer has reference to a device illustrated and described in your columns some time ago, which insures a direct distribution of stress to the various interconnecting members in timber framing. It consists of a steel plate with serrated edges turned alternately to one side and the other, normal to the plate, forming prongs. It is introduced between the jointed members, and when these are bolted together the prongs enter the timber on both sides, thus preventing slipping.

While the writer does not as a rule advocate leaving these "minor" details to the guesswork of the carpenter, it occasionally does happen that temporary structures of this sort must be erected at snap decision when in the field. However, with the application of a little judicious thought, such weaknesses as pronounced wedge-shaped joints could be eliminated. The contractors for this type of work would undoubtedly find the above-described product to be of material assistance and all that the manufacturers claim for it. European technical publications have advocated its use for quite a number of years, the results of its extensive use in timber framing of all description warranting this.

New York, Oct. 1. HERMAN J. SCHOENFELD, Structural Engineer.

Eyebar-Head Stress Analysis

Sir—Josef Beke in his interesting article on Stresses in Eyebar Heads, in your issue of Aug. 11, p. 234, uses loadings which I have had occasion to use in computing stresses in large circular pipes. In comparing my equations with his, omitting his normal stress terms, I find that though the X_o equations agree, the M_o equations do not agree in two of the terms. I get

$$M_o = -\frac{P_r}{2\pi}\left(\frac{W}{4\sin W} + \tfrac{3}{4}\cos W + \tfrac{1}{2} W \sin W + \frac{4}{\pi} - \pi \sin W - 1\right)$$

instead of his

$$M_o = -\frac{P_r}{2\pi}\left(\frac{W}{4\sin W} + \tfrac{3}{4}\cos W + \tfrac{1}{2} W \sin W + \frac{4}{\pi} - \tfrac{1}{2}\pi \sin W\right)$$

This looks to me like a typographical error in his article, as these equations were derived by two entirely different methods.

As the radius of his circle is small in comparison to its thickness he is correct in using his Z term instead of the usual I. For his example, where $d/a = \frac{3}{4}$ and $x/a = \frac{1}{4}$, this gives flexural stresses of $S = 10.53\ M/bx^2$ for the inner edge, and $S = 3.24\ M/bx^2$ for the outer edge, instead of the usual $S = 6\ M/bx^2$ for rectangular sections. Working from my equations with these factors I get for maximum stress, $S_x = 2.33\ T$, tension at inner edge, instead of his $2.57\ T$; $S_x = 0.16\ T$, tension at outer edge, instead of his $0.20\ T$ *compression;* $S_z = 0.58\ T$ instead of his $0.79\ T$; $S_y = 0.81\ T$ instead of his $0.76\ T$.

My greatest stress is 10 per cent less than his, which is caused by my neglect of the work of direct stress. This is probably an extreme variation, as some work which I have done on arch dam deflections showed a difference of less than 2 per cent. It seems to me that the work of direct stress should be included in curved beam problems only when the Z term differs materially from the beam moment of inertia; that is, when the depth of the section is greater than three-quarters of the radius of the neutral axis. Love's "Theory of Elasticity" gives a rigorous method of handling these problems, but it is too difficult for the ordinary engineer to use, on account of the advanced mathematics involved.

Mr. Beke is certainly to be complimented on the thorough analysis which he made of his problem.

San Francisco, Sept. 3. JAMES M. PARIS.

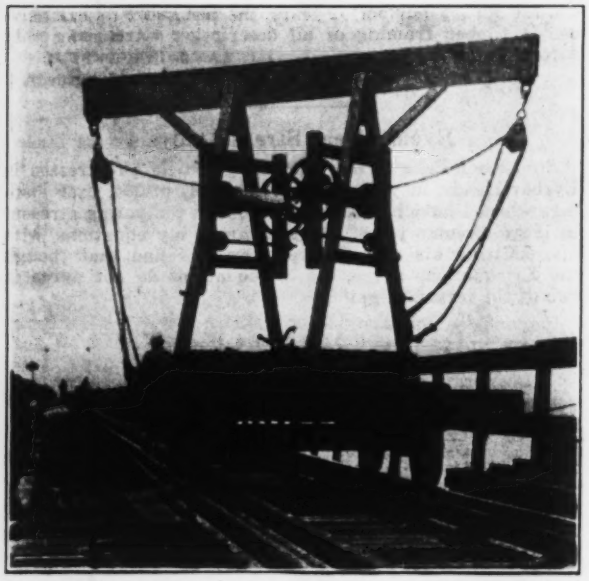
Manganese Bronze for Valve Stems

The article by William Conard, "Manganese Bronze for Water-works Valve Stems," in *Engineering News-Record*, Oct. 6, p. 575, should have been credited as an abstract of a paper read before the recent convention of the New England Water Works Association.

HINTS FOR THE CONTRACTOR

Crane on Push Car Handles Stringers

IN REDECKING 11.8 miles of trestle on the Lucin cutoff, on the Southern Pacific R.R., a push car was equipped with a crane and hand-operated winches for handling stringers which are 8 x 17-in. timbers, 30 ft. long. The crane and winches are mounted as a self-contained unit on a platform which is simply lifted and placed on a push car. By shifting the position of this platform on the push car the center line of the crane can be made to take any desired angle with the rails, thus varying the distance from track center line to the blocks suspended from the crane ends.



RAISING A STRINGER WITH THE PUSH CAR CRANE

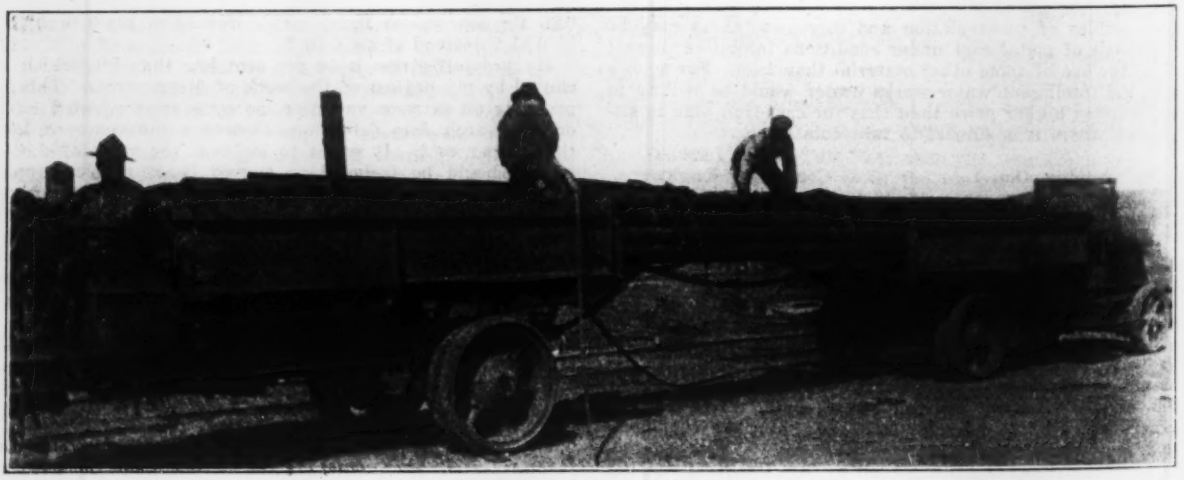
Stringers being removed from the deck are first shifted to a position just outside the ends of the ties where they are picked up by the block and tackle. Two hand-operated winches are mounted on the A-frames, one for each pair of blocks, which consist principally of the gears taken from old hand cars and shafts or drums 6 in. in diameter on which the rope is wound. The push car is ordinarily moved when a stringer has been picked up on each end, thus balancing the weight on the crane. The stringers are lifted with rope slings whose loops can be spread enough to maintain balance and keep the stringers in a horizontal position while being lifted and carried.

The superstructure, or crane proper, consists chiefly of two A-frames steadied by bracing around the bottoms and whose tops are connected by a 3 x 12-in. timber set on edge and from each end of which a pair of blocks is slung. This main beam of the crane is 14 ft. long and stands 7 ft. above the platform.

Two Trucks in Lieu of Truck and Trailer

ABOUT 180 tons of steel girders and sections of oil pipe ranging up to 40 ft. in length recently had to be delivered by motor truck from Rodeo, Cal., to Oleum, a distance of 1½ miles. The length of the pieces was so great that they could not be loaded on a single truck and R. O'Connell, the contractor, had no trailers available. Delivery was made promptly, however, by loading the material on two 5-ton trucks, backed up end to end, in which position they moved over the road, one going ahead and the backing. Thirty loads were transported in this way, averaging about 6 tons each.

Two advantages over the use of truck and trailer were found in using the two trucks (1) in climbing the grades which ranged up to 12 and 14 per cent the combined power of the two motors made it possible to maintain better speed, thus reducing the time required for the trip and (2) it was possible to turn very sharp corners by making a half turn as is done on a railroad "Y." Obviously careful attention was required in steering the truck which was operated backward, but with skilled drivers this was successfully managed. Other than the load and the chains used to hold it in place the two trucks were not directly connected.



TWO TRUCKS COUPLED BY LOAD OF LONG PIPE

NEWS OF THE WEEK

New York, October 13, 1921

Pueblo Arranges for Study of Flood Protection

Pueblo has arranged for an engineering study of its flood exposure and the possibilities of flood protection. The city and the county, with the advisory assistance of a citizens' committee of twelve, have employed the Dayton Morgan Engineering Co. as chief engineer of flood protection. B. M. Jones, heretofore resident engineer of the Lockington dam of the Miami Conservancy District, will be resident engineer, assisted by W. J. Smith as field engineer, up to the present assistant engineer on the Taylorsville dam of the Miami Conservancy District.

The provision of adequate state legislation under which flood protection work embracing a large area can proceed will be the first necessity of the work, and such legislation is already being prepared.

Propose Freight Transport in New York Subway

Co-operation in the solution of New York's port and transit problems was sought at a conference last week between the New York and New Jersey Port and Harbor Development Commission and the New York Transit Commission. A suggestion that the express tracks of the subway system be used for freight transport from 1 to 5 a. m. was considered, and referred to a committee on which the engineer members are Robert Ridgway, chief engineer, and D. L. Turner, consulting engineer of the commission.

Building Material for France To Come from Germany

Between now and May 1, 1926, France will receive from Germany, according to the terms of an agreement signed Oct. 6 by representatives of the two nations, building material to the value of seven billion gold marks.

Urge Passage of Zoning Law To Stimulate Building

An early passage of the proposed zoning ordinance by the board of commissioners of Dallas, Texas, is being urged by the metropolitan development association of the Chamber of commerce in order to stimulate the building industry. A zoning ordinance has been under consideration for some time and many are reluctant to build until the various zones are definitely located. The city at present regulates the location of business and industrial buildings by requiring the consent of three-fourths of the property owners living within a radius of 300 ft. of the center of the proposed structure, but this ordinance is unsatisfactroy.

Highway Departments Announce Policy on Letting Next Year's Contracts This Fall

"Engineering News-Record's" Inquiry Regarding Prospects for 1922 Road Construction Program Elicits Varied Replies

Following the announcement in the Sept. 29 issue of this journal of New York State's acceptance of the principle of letting next year's highway contracts this fall, as advocated recently by Herbert Hoover, Secretary of Commerce, Engineering News-Record requested from each state highway engineer a concise expression of the policy of his department. Some of the replies thus far received follow:

Massachusetts—"This State is going to let this fall all the contracts that can be let without overdrawing the appropriations that have already been made. We have several projects which would be let this fall if there were funds available. The large number of contracts let this year, however, used all the funds that are available before another session of the legislature."

—By A. W. Dean, chief engineer, Division of Highways, Department of Public Works.

Rhode Island—"This department anticipates contracting this fall for practically the entire amount of the construction work involved by our 1922 program."

—By I. W. Patterson, chief engineer, State Board of Public Roads.

New Hampshire—"All of our work is a state-aid proposition, town and state contributing jointly to the fund for the construction and maintenance of the highways. It is impossible for us to anticipate just what any town will do in regard to appropriations until after the annual town meeting in March. As soon after that time as possible, we will let our contracts for the 1922 construction.

"Our climate is such that it is impossible to do any work during the winter months and it is generally the first of May before any work may be begun. Nothing would be gained in our case, therefore, in letting the contracts in the fall, if it were possible."

—By F. E. Everett, Commissioner, State Highway Department.

Maryland—"The State of Maryland has no funds for the further construction of roads, and will have none unless and until federal aid passes, and then only a small amount, approximately $1,500,000. The legislature convenes in January; and we expect a substantial appropriation for construction next year.

"It has been the universal experience of this commission over a period of 15 years' successful road construction that better prices are obtained in the spring than in the fall. Actually, no road work is done in the winter except at tremendously increased costs, so that no advantage in actual construction accrues by reason of fall letting, and if it makes for higher prices, there is no advantage in it. Do not let us be fooled into believing that unemployment can be relieved by the awarding of contracts. It cannot be."

—By John N. Mackall, chairman and chief engineer, State Roads Commission.

Delaware—We expect to let next month two small grading jobs. Since our program for next year is but a tentative one at this time, we do not expect to advertise for bids on any other

Am. Soc. C. E. Casts Decisive Vote for Amended Constitution

A decisive vote in favor of the adoption of the amended constitution of the American Society of Civil Engineers was canvassed at the regular meeting in New York, Oct. 5. Of the total of 1,700 ballots counted, 1,367, or about 80 per cent, were affirmative. Changes in the constitution of the society must be approved by two-thirds of all votes cast so that, to carry, the amended constitution needed 1,134 ballots. The results showed a margin in favor of the passage of the amendments of 233 votes above the necessary two-thirds.

In comparison with the number of ballots cast by members on the previous questions affecting the society's policy, the present vote is light. A tabulation of the ballots is given herewith:

Total ballots counted	1,700
Voting "Yes"	1,367
Voting "No"	326
Invalid ballots	7
Required to carry	1,134
Carried by	233
Percentage "Yes"	80

Colonel Woods To Co-ordinate Employment Effort

Secretary of Commerce Herbert Hoover last week appointed Col. Arthur Woods, former New York City police commissioner, as head of a special committee of the National Conference on Unemployment at Washington, D. C., to co-ordinate efforts in providing work for jobless men and to serve as a clearing house through which methods used in various centers may be exchanged for mutual benefit. A number of cities have reported that they are organizing to meet the unemployment situation along lines suggested by the conference.

work until after the first of the year." —*By C. D. Buck, assistant to Chief Engineer, State Highway Department.*

Kentucky—"The State Highway Department has already awarded contracts on a part of next year's construction program and will during this fall prabably award all projects that will be under construction in 1922. I heartily agree with the recommendations made by Herbert Hoover, Secretary of Commerce."—*By Joe S. Boggs, State Highway Engineer.*

North Carolina—"We quite agree with the fall letting of contracts and we expect to hold a letting every ten days from now until the first of the year, putting under contract between $1,000,000 and $1,500,000 worth of work each month.

"We appreciate the great advantages of fall lettings and are attempting to take advantage of these points."—*By Charles M. Upham, State Highway Engineer.*

Ohio—"The Department of Highways and Public Works is now letting all work which can possibly be carried on during the fall and open season of the winter. We are sparing no pains to place all bridge work and grading work under contract and are holding sales continually at the present time, the first sale falling on Oct. 8.

"We are also preparing to sell during the winter paving work which could not be carried on during the cold weather for operation at the earlist possible moment in the spring.—*By Leon C. Herrick, Director of Highways and Public Works.*

Georgia—"I agree thoroughly with the idea of letting contracts in the fall of the year. In Georgia our best construction season is in the fall and up to the middle of December. We can also get more labor at this season of the year.

"We are, however, dependent upon funds for new construction, and the availability of state funds is contingent upon federal-aid appropriations. We have expended all the federal funds appropriated to date and are waiting the action of Congress.

"We have plans and surveys completed to let at least $3,000,000 worth of work within six weeks after federal appropriation has been made."—*By W. R. Neel, State Highway Engineer.*

Mississippi—"Regarding the letting of contracts for next year's program, this fall, the State Highway Department is so far behind with its work, that we are unable to do so."—*By H. C. Dietzer, State Highway Engineer.*

Wisconsin—"Our determination is not to let any of our 1922 work until on or about Jan. 15. We are arranging to push the completion of plans as fast as our forces permit, and we hope to complete our lettings on or about March 1, or as soon therafter as plans and specifications can be prepared.

"Even if we had the plans ready, we would let no contracts for next year's work at this time. In a climate such as Wisconsin has, where the field work on construction cannot start until April 15, there are no great advantages in fall lettings, and there are very radical disadvantages in the letting of contracts so far in advance of the actual performance. Of course, if contracting is to be made even more of a gamble than it is now, the letting of contracts for work to be done several months in advance, is advisable.

"I can also understand why the contractors' associations are anxious to secure contracts. I believe that next spring's prices, especially on early lettings, will be lower than present prices, and we expect to take advantage of the low market."—*By A. R. Hirst, State Highway Engineer.*

State Highway Engineers Announce Policies on Fall Lettings of Next Year's Road-Building Contracts.

Maine—"The State Highway Commission does not plan to let contracts this fall against next year's construction program. Thinking to expedite work we let two large contracts two years ago this fall. One of the jobs was not completed until the first of September of this year and the other one is just done now. When we let the work in the fall of 1919 it was with the expectation that both jobs would be completed during the construction season of 1920 but we have been unable to see that early letting expedited the completion of either one of these jobs.

"We usually have snow from about Dec. 1 until March 20. This snow varies in depth from 1 ft. in the southern part of the state to 4 or 5 ft. in the north, so that it is practically impossible to do any kind of road work during this closed season."—*By Paul D. Sargent, Chief Engineer, State Highway Commission.*

Kansas—"The State Highway Commission, while in favor of letting fall contracts, has not sufficient authority under the laws of Kansas to bring about any extensive program. The award of contracts on federal-aid road work is vested in the board of county commissioners, subject to the approval of the highway commission.

"We recognize a number of advantages in the fall awarding of contracts, although in a number of instances the contractor, after receiving a fall contract, has delayed until spring getting ready for the work and in the end nothing was accomplished. It largely depends upon the attitude of the contractor as to whether the fall awarding of contracts will prove satisfactory. It is a difficult proposition at this time to determine whether it will be a saving for the community to award these contracts in the fall, on account of the present downward trend of prices. A great many of our local officials are of the opinion that delaying until spring for the awarding of the contract will constitute a decided saving for their community and it is almost impossible to combat this argument as it has recently been shown that contracts are being awarded at a lower rate than a few months ago."—*By M. W. Watson, State Highway Engineer.*

Connecticut—"This matter has been agitated for some time by Secretary Hoover informally through letters to the Governor. After a conference with our Governor we decided to get out all the work possible during the present fall, so that the unemployment situation might be somewhat relieved.

"It is my personal opinion, however, that the solution of the unemployment situation does not lie entirely with the employment of unskilled labor. There are many men without positions at the present time who are not qualified, either by desire or ability, to do manual labor. Nevertheless, wherever it has been possible for us to do so, we have cut considerable red tape in order to take care of the employment of labor where it was badly in need of money. We are at the present time letting contracts just as fast as we can procure the plans for the work.

"To my mind, the desire for relief in the unemployment situation should in no case work to reduce the quality of construction put into our highways or into other public works. The amount of work that we can do is, of course, limited by the appropriations made by the legislature during the past session."—*By C. J. Bennett, State Highway Commissioner.*

South Carolina—"At present we are letting contracts just as rapidly as we can get plans in shape and financial arrangements made to pay for the work. Most of the work we are letting, however, will be commenced immediately and will be prosecuted through the winter months.

"In South Carolina we now have much idle labor and are more concerned with furnishing immediate employment to this labor than with getting contracts ready for next year's work.

"We do not believe that any considerable gain could be effected by letting contracts at the present time for next year's work. All through the early part of last year the State Highway Department exerted its influence to retard rather than accelerate road improvement work, because it was felt that nothing would be lost by waiting.

"Material prices from our point of view are still high, however, particularly in the case of cement, and we are inclined to postpone construction where these materials are to be used. We are, therefore, grading roads and constructing temporary surfaces of local materials and will use the high-priced materials only for necessary bridge and drainage structures, except in a few cases.—*By Charles H. Moorefield, State Highway Engineer.*

Conferees Agree on Federal-Aid Highway Bill

Prospects Hopeful for Enactment Before Nov. 1—Appropriation Left at $75,000,000

(Washington Correspondence)

All indications are that the highway bill, carrying an appropriation of $75,000,000, will have become a law by Nov. 1. After extended sessions on Oct. 6, 7 and 8, the conferees of the Senate and of the House of Representatives agreed upon a conference bill not greatly different from the one passed by the Senate. A separate vote must be taken in the House on the appropriation. There was some discussion of increasing the appropriation to $100,000,000, but it was believed to be better to submit $75,000,000 to the House.

One of the important changes in the bill was the increase from 1½ to 2½ per cent in the amount which may be expended for administering the act.

The conference bill provides that $25,000,000 of the appropriation is to become available immediately, while the remaining $50,000,000 is to be available Jan. 1. In the bill passed by the Senate the $50,000,000 was not to become available until six months after the passage of the act. Other changes agreed to in conference are as follows:

The provision that the act is not to apply to streets in municipalities having a population of 5,000 or more was changed so as to apply to a municipality with a population of 2,500.

The definition of "state highway department" was altered so as to provide that it must be formally organized.

A radical change was made in the language of Section 7, so as to make clearer that important part of the bill. As agreed on in conference, the section now reads:

"That before any project shall be approved by the Secretary of Agriculture for any state, such state shall make provisions for state funds required each year of such state by this Act for construction, reconstruction and maintenance of all federal-aid highways within the state, which funds shall be under the direct control of the state highway department."

The paragraph of the bill providing for maintenance by the federal government in cases where the state fails to do it was changed so that the state highway department is to have ninety instead of sixty days in which to act.

The paragraph of the bill which has been criticized as an effort to override state constitutions was changed in conference so as to read: "That in any state where the existing constitution or laws will not permit the state to provide revenues for the construction, reconstruction, or maintenance of highways, the Secretary of Agriculture shall continue to approve projects for said state until three years after the passage of this act, if he should find that such state laws conflict with the provisions of this act."

Two More Members for Federation

The executive board of the American Engineering Council, at its meeting in Washington, Sept. 30, approved applications for membership in the Federated American Engineering Societies of the Vermont Engineers' Society and the Associated Engineers of Spokane.

Kalamazoo Votes to Continue Under Commission-Manager Plan

A majority of 708 votes in a light total were cast at Kalamazoo, Mich., Oct. 4, against abandoning the commission-manager plan of city government, in effect for some three years past.

Saskatchewan Water District Plan May Be Revived

The urban governing bodies in the Saskatchewan Water District, Canada, are advocating a revision of the $6,000,000 water-supply project, defeated by rural votes on July 27, and another vote on the scheme. A. J. McPherson, consulting engineer, Regina, Sask., is chairman of the Saskatchewan Water Supply Commission. An outline of the project appeared in *Engineering News-Record*, April 22, 1920, p. 837

Ridgway and Holland Return

Robert Ridgway, chief engineer of the New York Transit Commission, which is charged with the construction of all New York subways, and Clifford M. Holland, chief engineer to the New York and the New Jersey tunnel commissions, which are responsible for the vehicular tube project under the Hudson River, have recently returned to New York City from Europe. Mr. Ridgway and Mr. Holland went abroad to study subway and vehicular tunnel practice in England and on the continent.

New York Section, Am. Soc. C. E. Announces Program

Confining itself largely to a discussion of problems relating to engineering in the metropolitan district, the New York Section, American Society of Civil Engineers has issued its program of meetings for the 1921-22 season. Several of the sessions will be held jointly with sections of the other national engineering societies and the number of invited speakers on each occasion has been limited to from 5 to 7, to allow opportunity for discussion from the floor.

The program committee, of which E. J. Mehren is chairman, announces as the subject for the first meeting on Oct. 19, "Financing Public Utilities and Large Engineering Projects."; A. B. Leach of A. B. Leach & Co., bankers, will be the principal speaker. Topics for future meetings include the St. Lawrence Ship channel, the Zoning law, traffic handling, removal of solid wastes the Port of New York, the proposed Hudson River bridge and regional planning.

Serves 50 Years in City Water Department

Walter H. Richards Retires as Engineer and Superintendent at New London, Conn.

After completing 50 years of service with the New London (Conn.) water-works, Walter H. Richards, who began his professional career as a pupil of Col. J. T. Fanning, the noted hydraulic engineer, and rose from the position of rodman to engineer and superintendent of the Board of Water and Sewer Commissioners, retired from active practice Oct. 1. He grew up with the department, for in 1872, when the city began to build its water-works system, he served as construction engineer under Mr. Fanning, the consulting engineer. When the work was completed Mr. Richards was appointed engineer and superintendent of the department and, with the exception of two years, has been engaged in those duties continuously.

Studies Microscopic Growths

His early work in the '70's led him into what was then a new field—the study of microscopic growths in water and the disagreeable tastes and odors caused by them. In 1879, in association with the late Prof. William Ripley Nichols, he began an investigation of tastes and odors in water and continued his researches, afterward, with Profs. Albert R. Leeds and William T. Sedgwick.

The usual duties of a water-works superintendent occupied Mr. Richards' time until 1886, when it was decided to construct a sewerage system from general plans prepared by Rudolph Hering, consulting engineer. Mr. Richards' previous services in building the water-works had made so favorable an impression upon the appointing powers that he was selected as engineer of the sewer department, which has, ever since the beginning, been under his direction. In administering the combined water and sewer departments he has had charge not only of the design and execution of engineering work, but the collection of all money, payment of bills, and ordering of supplies.

In his 50 years with the department he has witnessed many changes in water-works practice. On the original system for New London it was decided to use a 24-in. vitrified pipe with cement joints; no vitrified pipe was being made in the United States at that time and it was necessary to purchase the pipe in Scotland. Mr. Richards recalls also the necessity in the early days, of purchasing Portland cement in England. While the New London work was in progress nitroglycerine had just come into use for blasting purposes; it was

Hetch Hetchy Tunnel Progress for September

A total heading advance of 3,295 ft. was made in the rock tunnel of the Hetch Hetchy aqueduct of the San Francisco water supply during September. The August record of 776 ft. in a single heading, made at Priest Portal (see p. 464) Sept. 15 issue), was not equaled; 20 shifts were lost in that heading on account of timbering, so that only 70 shifts were worked, making 538 ft. of advance. The performances in the seven other headings ranged from 301 ft. to 489 ft. For all headings a total of 529 shifts was worked, with an average advance of 6.23 ft. per shift.

A. S. M. I. Issues Convention Program

The program for the twenty-seventh annual convention of the American Society of Municipal Improvements at Baltimore Oct. 25-28 has just been issued. A business meeting will be held on the morning of Oct. 25 and the afternoon will be devoted to subjects of street lighting, city legislation and utilities. There will be a dance in the evening.

Committee reports and technical papers are scheduled for the morning of Oct. 26. In the afternoon there will be an inspection of Baltimore harbor. A business session is announced for the evening.

The morning and afternoon of Oct. 27 will be devoted largely to paving matters, while an entertainment at the Press Club is scheduled for the evening.

Reports of committees and descriptive papers will close the convention on Oct. 28.

(Continued from preceding page)

purchased at a Government experiment station, carefully transported by water, landed outside the city and carried over selected roads to the work. In contrast to these precautions Mr. Richards recalls having seen nitro-glycerine often poured into a drill hole from a kettle.

Mechanical equipment for construction purposes has made startling progress since the early days of the New London water-works. Then the trench pump, now so common, was unheard of and a pipe trench through a swamp often required 100 men bailing with pails. The common tools and plant used today by contractors were not then available, although Mr. Richards remembers that men could be had in plenty at 15c. per hour.

During his half-century of service at New London Mr. Richards has been in charge of the construction of four dams and reservoirs, one distribution reservoir, two high service systems, the entire city sewerage system and the maintenance of all these works after construction. He read the first paper before the New England Water Works Association in 1884 on the subject "Service Pipe" and is an honorary member of that organization.

Welcome Fritz Medal Delegation

Present and past officers of the four (founder) national engineering societies, the Engineering Foundation, the United Engineering Society and the Federated American Engineering Societies at a dinner in New York Oct. 10 welcomed home the delegation of twelve engineers who last summer presented to Sir Robert Hadfield and Eugene Schneider the John Fritz medals awarded them, respectively, for the years 1920 and 1921.

Members of the delegation described the ceremonies in London and Paris, while cablegrams of greeting were read from the leading British engineering societies, from the Société des Ingénieurs Civils de France, Viscount Bryce and Eugene Schneider and Sir Robert Hadfield. Sir Robert urged close relations between all English-speaking engineers, and proposed that there be formed an international engineering council. M. Schneider also endorsed the idea of international organization among engineers.

John R. Freeman, as a representative of the civil engineers' group in the delegation, described a trip made by him and Robert A. Cummings with some forty French engineers through southeastern France, inspecting the extensive water power developments there and the work of extending the harbor of Marseilles. A new industrial district is developing in that section, far from the German frontier.

Captain G. H. Armstrong, British Consul-General at New York, and Gaston Liebert, French Consul General at New York, expressed the appreciation of their nations for the co-operation of American engineers in the war and of the honor carried to their countries by the conferring of the John Fritz medals. M. Liebert, on behalf of the French Government, then presented to the chairman of the delegation, Ambrose Swasey, to the chairman of the civil, mechanical, electrical and mining groups in the delegation and to the presidents of those four societies medals commemorative of the visit of the delegation.

Prof. Jacques Cavalier, rector of the University of Toulouse, exchange engineering professor, spoke briefly.

J. Vipond Davies, president of the United Engineering Society, presided.

Daily Rate for Concrete Paving Averages 733 Feet

On a concrete paving job recently completed in Tehama Co., Cal., a daily average of 733 lin.ft. of 15-ft. pavement was maintained for 98 working days, according to the California Highway Commission. The contract, which was for 13.8 miles and was held by H. J. Kaiser, was started March 21 and finished Sept. 16. The average progress was 3.58 miles per month. The pavment is 5 in. thick and is reinforced.

Army Engineers Against Ohio-Lake Erie Canal

Rivers and Harbors Board Believes Cost Not Now Justified by Traffic Prospects

After considering the report of a special board of negineers on canal routes connecting Lake Erie with the Ohio River, the Board of Engineers for Rivers and Harbors, of the Corps of Engineers, U. S. Army, is not convinced that sufficient commerce would develop over any of the routes considered to justify such an undertaking. The matter is being held open, however, for 90 days.

The special board which made the report consisted of Cols, William V. Judson, William W. Harts and Edward M. Markham. In connection with the further consideration of this project, the board has issued the following statement:

BOARD'S STATEMENT

"The special board states that Route 1 (Pittsburgh to Ashtabula) is the shortest, will be the cheapest of construction, and the one offering the greatest prospective commerce, and is preferred by that board. It recommends some further investigation of its economic features. It believes that if the improvement is undertaken over any of the routes the states or other local interests concerned should co-operate to the extent of paying 70 per cent of the first cost, leaving the United States to pay 30 per cent of the first cost and all charges for subsequent maintenance and operation.

"This report has, in accordance with law, been referred to the Board of Engineers for Rivers and Harbors for consideration and recommendation. This board is not convinced of the advisability of the United States undertaking the construction of any canal between Lake Erie and the Ohio River at the present time for the following reasons: The least expensive route, and apparently the most promising, is the Pittsburgh-Ashtabula route, which is estimated to cost the large sum of $120,000,000. Moreover, the existence of obstructive bridges across the Alleghany River near its mouth further militates against the advisability of constructing a canal along this route. The Cincinnati-Toledo route is estimated at $195,000,000 and with the Lake Michigan branch at nearly $400,000,000, and the intermediate routes at $175,000,000 to $225,000,000. These large sums could be justified only by an assured commerce of great magnitude, estimated by the special board at not less than 20,000,000 tons a year. The Board of Engineers of Rivers and Harbors is not convinced that such a commerce would develop over any of the routes considered and, as there is doubt of the ultimate economic success of the undertaking and every effort is now being made to reduce national expenditures, it does not feel justified in recommending the improvement at such great cost at this time."

Support San Francisco Bay Bridge Project at Army Hearing

On Oct. 7 Col. Herbert Deakyne, Corps of Engineers, U. S. A., representing the War Department, conducted a public hearing in San Francisco on the question of bridging San Francisco Bay. Ralph Modjeski presented the tube-and-bridge project recently recommended by J. Vipond Davies and himself and then plans for twelve other projects were filed, after brief explanation by proponents and discussion of each. The projects ranged from tunnels 200 ft. below water to cantilever bridges 200 ft. above, with locations ranging from Dumbarton Point, 30 mi. south, to Telegraph Hill, nearly a mile north, of Market St. Speakers from all parts of the Bay region expressed a desire to see agreement on some feasible plan.

In opening the hearing, Col. Deakyne said the War Department would be concerned with questions of whether any proposed structure would answer its purpose without unreasonably obstructing navigation or reducing the tidal prism to such an extent as to effect the channel through Golden Gate. In closing the hearing he said: "I shall recommend to the War Department that some policy be adopted as to the location and type of structures that would be approved so that those interested can proceed with studies."

Changes in Labor Policy Needed in Canal Zone, Says Commission

Radical changes in the policies of the Federal government toward the employment, pay and working conditions of labor in the Canal Zone at Panama are recommended in a report which a commission, consisting of Brig.-Gen. W. D. Connor, formerly of the Corps of Engineers, Capt. A. B. Fry, of the Treasury Department, F. A. Molitor, consulting engineer of New York and H. A. Wilson, New York business man, has just submitted to the Secretary of War.

Among the recommendations contained in the report are that the Governor of the Canal Zone deal with labor, not through labor organizations, but through committees of employees; that the open-shop principle be put into effect on the Isthmus; that the Canal administration be free as to its policy in employing union, non-union or tropical labor; that free housing, light and heat be discontinued; and that the operation of the Panama Canal and the Panama railway and steamship lines be separate and distinct.

President Samuel Gompers, of the American Federation of Labor, according to his own statement is "astounded" by the "proposal to displace citizen American workers with alien workers at . labor wage rate on a non-union basis."

The Connor commission reports that an estimated annual saving of $5,000,000 would result from following its recommendations.

Buffalo Takes Over Hog Feeding from Garbage Contractor

The City Commission of Buffalo, N. Y., voted on Oct. 6 to buy, operate and improve the plant of the Huff Feeding Corp., contractor for disposal of the garbage of the city by feeding to hogs. The City Commission has appropriated $200,000 for the feeding plant and hogs and the proposed extensions and improvements.

Dallas Awards Garbage Contract

Dallas, Texas, has recently awarded a contract to the Superior Garbage Incinerating Co. for the building of four incinerators in different sections of the city to replace refuse dumps that are now in use. The total cost will be $162,643 and the largest plant will have a capacity of 40 tons in 12 hours. The money for the construction of the incinerators is provided by a 200,000 bond issue voted last April.

Seattle's Right to Restaurant Garbage To Be Tested

The legality of an ordinance recently passed by the city council of Seattle, Wash., providing that the city may sell all garbage produced in restaurants in that city and naming the Pacific Meat & Packing Co. as its sole authorized agent for the collection of this garbage, is to be tested in the courts. The restaurant keepers, who formerly sold their garbage or fed it to hogs on their own ranches claim that the ordinance, by depriving them of this privilege, violates their property rights under the constitution of the United States.

Bids for 300-Ton Garbage Plant Wanted at Montreal

The Administrative Commission of Montreal, Que., invites bids until Oct. 20 for a 300-ton garbage and refuse incinerator. Included in the contract will be a steam heating plant, supplied by the incinerator and able to heat the building to 60 deg. F. when the outdoor temperature is —30 deg. F.

To Extend Canadian Railroad at Cost of $3,500,000

The Ontario Government has decided to proceed with the extension of the Temiskaming & Northern Ontario Railway from its present terminus at Cochrane to a point 70 miles north known as Tin Can Portage on the Abitibi River. The cost is estimated at $3,500,000. In addition to opening up a good agricultural district for settlement the construction of the line will make it possible to develop at least 300,000 hp. at intervals along the river. The main development it is estimated will furnish about 200,000 hp. Preliminary surveys show that a fall of over 200 ft. can be established at Tin Can Portage, while an additional 111,500 hp. can be generated at other points within 7 mi.

Hiram F. Mills, Hydraulic Engineer, Dead

Was Honorary Member of Am. Soc. C. E.—Lawrence Experiment Station Largely the Result of His Efforts

Hiram Francis Mills, noted hydraulic and sanitary engineer, honorary member of the American Society of Civil Engineers, a leader in the development of the art of water purification and sewage treatment, and responsible, in large measure, for the establishment of the Lawrence Experiment Station of the Massachusetts State Board of Health, whose committee on water supply and sewage he headed, as chairman, for many years, died Oct. 4, at his home in Hingham, Mass., after a long illness. He was 85 years old, and in 1917, on account of advancing years, had retired from active practice as chief engineer of the Locks & Canals Co. at Lowell.

Mr. Mills was born in Bangor, Me., Nov. 1, 1836, and was graduated from Rensselaer Polytechnic Institute in 1856. Much of his early engineering work was in the hydraulic field; he served on the Bergen tunnel of the Brooklyn water-works, on water power measurements at Cohoes, N. Y., and Lowell, Mass., and on the construction of a dam across the Deerfield River. For a time he was resident engineer at the east end of the Hoosac tunnel and on railway location in Nova Scotia. It is said of Mr. Mills that, as a young man, he resolved, during the first ten years of his professional work following graduation, to serve only under the most distinguished engineers, and it is worth noting that in those days he was associated with such leaders as Charles S. Storrow, James P. Kirkwood, James B. Francis, and William E. Worthen.

Hydraulic Research Work

In 1869 he became chief engineer of the Essex Co. which controls the dams, locks and water power on the Merrimac River at Lawrence, and in 1894 he was selected as chief engineer of the Locks & Canals Co. of Lowell, holding both positions simultaneously. At Lawrence he carried on an extensive program of hydraulic experiments on methods and instruments for the measurement of water power furnished to the mills and brought the efficiency of the pitot tube to a point never before reached.

Mr Mills is, perhaps, most widely known for his work as a member of the Massachusetts State Board of Health from the time of its reorganization in 1886 until it was legislated out of existence in 1914. Serving without remuneration during that long period as chairman of the board's com-

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; Annual Meeting, New York City, Oct. 18-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

The American Water Works Association, New York Section, at its noonday meeting at the Hotel McAlpin, New York City, Oct. 14, will be addressed by Lt.-Col. Theodore A. Leisen, on the "Public Works of Detroit."

The Albany (N. Y.) Society of Civil Engineers and the **Albany Chapter, American Association of Engineers** held a joint meeting Oct. 4, which was addressed by Herbert S. Sisson, state highway commissioner on "The Progress and Development of the Highway System of New York State."

The Technical Club of Dallas, Tex., at a recent meeting, launched a constructive program whereby members will make a concerted effort to encourage building and construction activities. The club is urging that bond money be put in circulation on public works projects in order to aid the unemployed. The activities of the club were the subject of a commendatory editorial in a recent issue of the Dallas *Daily Times-Herald*.

The Texas Section, Am. Soc. C. E. will hold its fall meeting Oct. 28 and 29, at which the Technical Club of Dallas will entertain the members and ladies.

The Providence, R. I., Engineering Society, Municipal Section, at its meeting Oct. 25, will be addressed by Almon L. Fales, of Metcalf & Eddy, Boston, Mass., on "The Relation of Stream Pollution in the Problem of Sewage Treatment."

(*Continued from preceding page*)

mittee on water supply and sewerage, he inaugurated a comprehensive system of examinations of water supplies in Massachusetts and took a leading part in the establishment of the Lawrence Experiment Station, the work of which is well known to every sanitary engineer in this country and abroad.

In 1892 Mr. Mills planned and had general oversight of the construction of the slow-sand water filter at Lawrence which has been characterized as "the first large scientifically designed municipal filter in America" by H. W. Clarke, for years chemist of the health board. This filter plant practically eliminated water-borne typhoid at Lawrence and stimulated filter construction throughout the country.

Among the important public enterprises with which Mr. Mills has been connected in a position of high responsibility may be mentioned the preliminary studies for the improved sewerage and drainage of the Boston metropolitan district, the water supply of the Boston metropolitan district, the damming of the Charles River, and various lines of investigation in connection with the general subject of public health. Mr. Mills continued in the active practice of his profession until he had passed the age of 80.

Personal Notes

M. M. WYCKOFF has organized the Wyckoff Engineering Corp., New York City, to engage in general engineering and contracting.

CLARK E. JACOBY, consulting engineer, Kansas City, Mo., has been elected president of the National Drainage Congress.

HARDY CROSS has been appointed professor of structural engineering in the College of Engineering, University of Illinois. He received the degree of B. S. in Civil Engineering from Massachusetts Institute of Technology in 1908 and the degree of Master of Civil Engineering from Harvard University in 1911. Prof. Cross was for six years assistant professor of civil engineering and instructor in structural engineering at Brown University and has specialized in structural and hydraulic engineering with consulting engineers since 1908.

CLYDE P. PYLE, since 1913 engineer with the McClintic-Marshall Co., bridge builders, has been appointed assistant professor of structural engineering at the University of Illinois. He received the degree of Master in Civil Engineering from the University of Pennsylvania in 1917.

C. K. MATHEWS, recently engaged in engineering and contracting on municipal improvements with Burns & McDonnell, consulting engineers, Kansas City, Mo., has been appointed instructor in civil engineering, University of Illinois. He was graduated from the University of Kansas with the degree of B.S. in Civil Engineering in 1919.

WALTER T. MORROW, who since his graduation from the University of Colorado with the degree of B.S. in Civil Engineering, has been engaged in structural engineering with the New Jersey Zinc Co. and the Semet-Solvay Co., has been made instructor in structural engineering at the University of Illinois.

RAYMOND A. WARNER, formerly with the city engineer of Detroit, Mich., has been appointed assistant city engineer to H. R. O'Mara at Mt. Clements, Mich.

PETER C. SPENCE, since 1914 engineer and specialist in building construction, ventilation and accident prevention in the New York State Department of Labor, has been made manager of the construction department of the National Lime Association, Washington, D. C.

C. J. CONLIN, for 3 years road engineer of Cuyahoga County at Cleveland, Ohio, has been appointed construction engineer for the North Carolina State Highway Commission, District 4, at Durham, N. C.

R. L. JONES, formerly chief engineer of the Sutter Basin Co., Sacramento, Cal., has been appointed office engineer, division of engineering and irrigation, State Department of Public Works.

F. D. HUDGINS, formerly senior highway engineer, U. S. Bureau of Public Roads, with headquarters at St. Paul, has been appointed state highway engineer of South Dakota, with headquarters at Pierre.

COL. CHARLES W. KUTZ has been designated to take charge of the work of the Corps of Engineers in the central division, with headquarters at Cincinnati.

E. E. S. MATTICE, formerly general contracting engineer, Dominion Bridge Co., Ltd., has been appointed managing director of the Phœnix Bridge & Iron Works, Ltd., Montreal, Que.

D. W. HAYS, consulting engineer, of Spokane, Wash., and at one time general manager of the Canada Land & Irrigation Co., Medicine Hat district, has been appointed supervising engineer of the United Irrigation District, Alberta, Canada.

ROLAND A. MUENSTER, formerly engaged in road work in Dallas County, and, for a time, city engineer of Austin, has been appointed assistant county road engineer of Bell County, Tex.

WALTER E. MILLER has recently completed for the Tennessee Eastern Electric Co. and the Johnson City Traction Corp. valuations of their properties at Johnson City and other points in eastern Tennessee, and has returned to his private consulting engineering practice in Madison, Wis.

J. W. CALDER, city engineer of Swift Current, Sask., has been dismissed by the city council, due to a policy of retrenchment.

HENRY C. MCMORDIE, formerly chief engineer for the Trussed Concrete Steel Co. of Canada, Ltd., has entered private engineering practice with offices in Windsor, Ont.

GEORGE E. WATTERS has been appointed engineer of the Board of Water and Sewer Commissioners, New London, Conn., succeeding Walter H.

Richards, who on Oct. 1 completed 50 years of service, as noted more fully elsewhere in this issue.

CHARLES D. CONKLIN, JR., formerly New York and Philadelphia district engineer for the Austin Co., has been appointed chief engineer in charge of construction with the W. P. Cameron Engineering Co., Philadelphia, Pa.

F. H. JOYNER, formerly road commissioner for Los Angeles County, Cal., has been employed by the California Highway Commission as assistant highway engineer in charge of general inspection for the southern district. Mr. Joyner's territory will include all of southern California and the territory east of the Sierra Nevada Mountains, including Mono and Inyo Counties.

A. W. VINCENT has been appointed city engineer of Albany, Ga.

C. A. MARTIN has been appointed construction engineer on paving and sewer work for the city of Puyallup, Wash.

OBITUARY

GEORGE A. FLETCHER, former city engineer and water-works superintendent, died recently in Pitcher, Okla. He was 57 years old.

WILLIAM J. DAVIS, engineer, Wayagamack Pulp & Paper Co., Three Rivers, Que., died Sept. 2. He was born in Lachine, Que., 1884. He was connected with the Dominion Bridge Co. for about 8 years as draftsman, checker of details, chief draftsman of the Winnipeg plant, and, later, construction engineer supervising all work of a construction or engineering character and acting as assistant to the Western manager.

WILLIAM H. GAMBLE, for more than 26 years a maker of copper plates for the U. S. Geological Survey maps, died in Washington, Sept. 15. He was born in Philadelphia in 1835. In his younger days he served as a topographic engineer and in 1882 he accompanied a private expedition into Labrador.

BUSINESS NOTES

THE NATIONAL PAVING BRICK MANUFACTURERS Association has added to its staff Stanley A. Knisely as economist. His work will consist in making economic studies of the service rendered by brick pavements. Mr. Knisely has had experience on a number of financial and technical journals as an investigator and writer on banking and industrial problems, and comes to the association from the Cleveland *Plain Dealer*, where he was a writer on economic subjects.

THE SCHAFFER ENGINEERING & EQUIPMENT CO. announces the combining of its administrative, sales and manufacturing departments in its new general offices adjacent to the factory in Pittsburgh, Pa.

THE METALS COATING CO. OF AMERICA, manufacturers and distributers of the Schoop metal-spraying process, by means of which metallic coatings of any kind may be sprayed onto any surface, are now installed in their new plant at 495 North Third St., Philadelphia, having removed from their former location in Boston and Woonsocket, R. I.

THE STERLING WHEELBARROW CO., Milwaukee, Wis., manufacturers of equipment for contractors and foundries, has appointed George H. Lambkin, who has been associated with the company for the past twelve years, manager for the New York territory.

THE ARTHUR SACHSSE CORP., New York, has been formed by Arthur Sachsse, and Felix F. Wiener, to promote the sale of patents, formulas and processes. The corporation will deal principally with the exploitation of inventions and developments made during the war in Germany and will offer manufacturers' rights to American firms. Associated with them are several patent attorneys.

THE CENTRAL STEEL CO., the National Pressed Steel Co. and the Massillon Rolling Mill Co., all of Massillon, Ohio, have been merged into a single organization. The name of the new concern will be the Central Steel Co. The total production of the combined mills is approximately 450,000 tons annually. The officers of the new company are: Chairman of the board of directors and president, E. Bebb; vice-presidents, F. J. Griffiths, C. B. Chase, and H. M. Naugle; secretary and treasurer, T. E. Stuart.

THE YEOMANS BROTHERS CO., Chicago, manufacturing sewage ejectors and drainage pumps, announces the following new representatives: P. E. Fallon, Gazette Bldg., Little Rock, Ark.; Morton McI. Dukehart & Co., McComas and Race Sts., Baltimore, Md.

EARL F. HEIMPEL, formerly chief engineer Edison Portland Cement Co., Stewartsville, N. J., has resigned to enter the sales force of the M. J. Dougherty Co., piping fabricators and engineers, of Philadelphia, Pa.

F. V. SHANNON has resigned as vice-president and secretary of the Massey Concrete Products Corp., and G. H. Redding has been elected secretary of this and affiliated companies. The position of vice-president will remain vacant for the present. David A. Hultgren has been appointed resident manager at Chicago.

R. K. SWIFT has resigned as manager of the New England sales branch office of the Ingersoll-Rand Co. He was connected with this company for 10 years as a salesman and 8½ years as general manager of the New England office.

EQUIPMENT AND MATERIALS

A New Line of Hoists

The Treadwell Engineering Co., Easton, Pa., has placed upon the market a new line of both steam- and electric-driven hoists. Heretofore the Treadwell Engineering Co., though a long-established manufacturer of rolling-mill equipment, has not been so closely identified with the building of hoists. Thomas O. Werner, formerly chief engineer of the hoist department of the S. Flory Manufacturing Co., has been secured as the chief engineer of the hoist department for the Treadwell Engineering Co. The Treadwell hoist is a machine that will meet practically any operating conditions with an arrangement from 100 to 300 hp.

Clay Tunneling Winch and Hoist

Compactness in construction and accessibility to various parts are two of the outstanding characteristics of the Model A clay tunneling winch recently placed on the market by the Miller-Selden Electric Co., Detroit, Mich. A natural accompaniment of this winch is the Model B hoist, distributed by the same concern. Both pieces of equipment are essentially the same in most particulars and all parts, with the exception of the drum and shaft, are interchangeable. In the case of the winch, the diameter of the drum is 6 in., its length 7¾ in., and the diameter of the flanges is 16 in. The drum of the hoist has a diameter of 4½ in., its length is 21½ in., and the diameter of the flanges is 16 in. The winch is arranged for direct connection by means of a flexible coupling to any type of electric motor. The winch is 22 in. wide, 24 in. high and 5 ft. 3 in. long.

Principle of Rapid Computer

The Keuffel & Esser Co., Hoboken, N. J., manufacturers of mathematical and surveying instruments, have made objection to the following sentence used in an article on "An Improved Rapid Computer," which appeared in this section in the issue of Sept. 1, 1921: "In graduations it is like the original instrument, being built on the principle of the polyphase duplex slide-rule." The statement of the Keuffel & Esser Co., regarding the matter follows:

"The words 'polyphase' and 'duplex' are registered trademarks of ours and refer to a K. & E. slide-rule, which in construction and principle is very much unlike the computer it is compared to in your article. Through the manner in which the polyphase duplex slide-rule is mentioned in the sentence quoted above, the reader might gain the impression that both these calculating devices are made by the same firm, which, by misleading the public, might give our competitor a certain advantage derived from the good will which we have built up with our renowned trade marked product."

Business Side of Construction

Facts and Events that Affect Cost and Volume

Public Bond Sales in September Heaviest in 22 Years

Municipal bonds sales in September totaled $86,477,162, as against $106,396,153 in August, and $102,700,291 in July, according to the *Commercial and Financial Chronicle*. This is the heaviest September in the last 22 years, the September, 1920, total being only $49,820,768, and $26,025,969 for September, 1913. The output of the last nine months was $756,166,681, against $489,176,223 for January-September, 1920. The following partial list of public bond sales sketches the general situation.

PUBLIC BOND SALES OF AUGUST AND SEPTEMBER, 1921

State	Purpose	Amount	Maturity	Rate per Cent	Sold for	Dated
Delaware	Highway	$500,000	1962	4½	92.18	Jan. 1, 1921
Oregon	Highway	1,000,000	1925	6	100.51	Oct. 1, 1921
County						
Fairfield, Conn.	Bridge	250,000	1951	5½	113.025	Oct. 1, 1921
Fillmore, Minn.	Road	53,844	1936	5½	101.11	Oct. 1, 1921
Hardin, Ohio	Bridge	79,250		6	100.00	Oct. 1, 1921
Marshall, So. Dakota	Drainage	101,000	1930	7	100.00	Sept. 1, 1921
Scott, Mo.	Road	106,000	1925–1937	5	100.00	Sept. 1, 1921
Stevens, Minn.	Highway	35,000	1931–1939	6	102.89	Sept. 1, 1921
Sweetwater, Wyo.	Road	300,000	1931–1941	6	100.00	Aug. 1, 1921
Albany, N. Y.	Highway and Bridge	304,000		5½	100.00	Sept. 1, 1921
Gem, Ida.	Bridge	75,000	1931–1941	6	93.60	Sept. 1, 1921
Santa Cruz, Cal.	Highway	209,000	1922–1941	6	102.61	Aug. 1, 1921
Township						
South Orange, Essex Co., N. J.	Park	125,000	$2,000 (1921–22) $3,000 (1923–63)	6	100.044	May 1, 1921
Municipality						
Newark, N. J.	Water	978,000	1923–1961	5½	102.31	Sept. 15, 1921
	Street Cleaning Dept.	75,000	1922–1926	5½	100.208	Sept. 15, 1921
	Asphalt Plant	50,000	1922–1931	5½	100.10	Sept. 15, 1921
Atlanta, Ga.	Street Improvement	136,500	1931	6	102.30	Sept. 1, 1921
Blair, Neb.	Paving	24,993	1940	7	100.00	Dec. 1, 1920
Casa Grande, Ariz.	Light and Water	120,000	1921–1941	6	100.00	
Cedarburg, Wis.	Water and Sewage	85,000	1921 Annually	6	104.14	Sept. 15, 1921
Fairport, N. Y.	Drainage	115,000	1922–1931	6	100.01	July 1, 1921
Frankfort, Ky.	Sewer	75,000	1941	6	105.18	Jan. 1, 1921
Franklin, N. H.	Water Works	80,000	$6,000 (1922–26) $5,000 (1927–36)	5	98.80	Oct. 1, 1921
Asbury Park, N. J.	City Improvement	50,000	1923–1972	4¼	100.00	Sept. 27, 1921
Happy Valley Irrigation District, Shasta Co., Cal.	Irrigation	100,000	Interest Semi-Annually	6	96.00	July 1, 1921
Lexington, Neb.	Paving	10,000	1940	7	100.00	June 1, 1920
Long Beach, N. Y.	Municipal-Improvement	240,000	1925–1949	6	100.68	Sept. 23, 1921
Paullina, Iowa	Lighting	27,000	1925–1931	6	100.00	July 1, 1921
Stevens Point, Wis.	Sewer and Pavement	75,000	1924–1940	6	103.68	Sept. 21, 1921
East Newark, N. J.	Sewer	107,000	1922–1941	6	100.79	July 1, 1921

Building Material Supply Firms in Cincinnati Indicted

Indictments were recently returned against fifteen firms and thirty individuals engaged in the supply of building materials in Cincinnati. The indictment charges that through their combination these dealers were able to control the purchase of cement in the Cincinnati market.

Steel Corporation Tonnage Grows

According to the monthly unfilled tonnage report of the U. S. Steel Corporation unfilled orders on the company's books as of Sept. 30 totaled 4,560,670 tons, an increase in the month of 28,744 tons.

*For partial list of July and August sales see *Engineering News-Record, Sept. 29, 1921, p. 516.*

Legality of Income Tax from Loan Associations to Be Tested

James A. Devine, secretary of the Ohio Building and Loan Associations League, will soon start suit in the U.S. Courts to test the legality of the income tax as it applied against building and loan associations in Ohio that lend money to non-members on endorsed notes or real estate security. Under a ruling of the Internal Revenue department all building and loan associations that make loans other than to members are subject to the payment of income tax on income accruing from such loans. Ordinarily Building and Loan Associations are exempt from payment of income and excess profits taxes. The action follows a thorough discussion of the matter. With the loan companies relieved of the tax, money would undoubtedly be easier and this would stimulate home building.

Cement Production in 1920 Highest on Record

The production of Portland cement in 1920 was 100,023,245 bbl., exceeding the next highest year, 1917, by 7,209,043 bbl., according to the U. S. Geological Survey. The 1920 production is an increase of almost 20,000,000 in excess of the 1919 production.

The shipments in 1920 amounted to 96,311,719 bbl. valued at $194,439,025, and in 1919 85,612,899 bbl.

Lumber Advances in Five Cities

One of the remarkable changes that has occurred during the week in the prices of construction materials has been an advance in lumber, reported simultaneously from five widely-separated American cities. The increases are from $1 to $3 per thousand feet. Details concerning these and other price changes can be found on page 632 of this issue, both in the table and in the discussion below it.

Westinghouse Receives $7,000,000 Railway Contract from Chile

The Westinghouse Electric International Company announces confirmation of a contract to supply the equipment to electrify the Chilean State Railroad between Valparaiso and Santiago and the Los Andes branch. The contract, which has a total value of $7,000,000 was awarded the American firm in competition with German and European companies. The contract covers railway electrification of 116 miles now under steam operation which connect Valparaiso with Santiago. The Los Andes line is 28 miles long and forms the Chilean State Railway section of the transcontinental line to Buenos Aires.

The equipment to be furnished includes 11 local passenger locomotives, 15 freight locomotives, 7 switching engines and 5 sub-stations of 4,000 kw. capacity each.

New York-Atlantic City Hard Paved Route Opened

Completion last month of 37 miles of continuous concrete pavement in New Jersey between Berlin and Absecon makes it possible by means of State Highway Route 3, or the Whitehorse Pike, to motor from New York to Atlantic City via Trenton and Camden over a smooth hard pavement, winter and summer. About 350 motor cars formed in line of parade at the Philadelphia-Camden ferries, whence they proceeded over the new highway to Atlantic City, where a ceremonial was arranged by the Hotelmen's Association and the Chamber of Commerce.

The pavement is of concrete, 1:2:3 mix, 6 in. thick at the sides, 8½ in. at center. Approximately 26 mi. of the new road is 18 ft. wide and 10 mi. is 20 ft. wide, both stretches having 3-ft. gravel shoulder on each side. Reinforcing was considered unnecessary since the pavement is laid on a porous sandy soil, providing an excellent foundation with little danger of heaving by frost. Thorough marking for distance, direction and danger points add to the safety and convenience of motorists.

California Highway Commission Receives Cement Bids

The following item comes from the California Highway Commission:

The California Highway Commission has awarded the contract for furnishing 1,815 bbl. of portland cement to the Old Mission Portland Cement Co., San Juan Bautista. The commission received three bids: From the Pacific Portland Cement Co., Santa Cruz Portland Cement Co., and the Old Mission. The bids were identical: $2.98 per barrel delivered at Ceres, Stanislaus County.

The commission also awarded a 504-bbl. purchase to the Santa Cruz Portland Cement Co. On this item there were only two bidders, the above company and the Pacific Portland Cement Co. Both bids were identical—$2.84 per barrel, delivered at Ignacio, Marin County—although the plants of the two companies are far apart.

The purchase of 6,400 bbl. was awarded to the Riverside Portland Cement Co. for delivery at Goleta in Santa Barbara County at $2.66 per barrel. Here there were five bidders, all southern California plants and all quoting different prices ranging from $2.66 to $2.88 per barrel.

Contractors Attack Oklahoma Eight-Hour Law

Contractors in Oklahoma have attacked one section of the eight-hour law of the state, providing that "no less than the current rate of per diem wages in the locality where the work is performed shall be paid to laborers, workmen, mechanics, etc., doing public work." A demurrer of the defendant contractors has been sustained by the county court at Pawhuska in Osage County, "on the ground that the current rate of wages provision of the law related only to time worked in excess of 8 hours, the judge holding that the law was passed for the purpose of regulating hours and not the price of labor in the state." The courts of Oklahoma have never passed upon this section of the labor law.

The above-mentioned case is being prepared for presentation to the criminal court of appeals for determination. —*Monthly Labor Review.*

Decrease in Retail Food Costs in Ten Principal Cities

Through the Bureau of Labor Statistics the United States Department of Labor has completed compilations showing changes in retail cost of food in September in ten principal cities of the United States. During the month closed Sept. 15 there was a decrease in all but one of the cities, Richmond being the exception. In Baltimore and Chicago there was a decrease of 3 per cent; in Manchester, 2 per cent; in Bridgeport, Butte, New York, and Providence, 1 per cent; in Peoria and Washington, D. C., there was a decrease of 0.4 per cent.

Pennsylvania Lets Road Contracts—Bids Received by New York

Contracts for the construction of about 16 miles of reinforced-concrete roads were let during the past week by the Pennsylvania Highway Department, calling for the expenditure of more than three-quarters of a million dollars. There are eleven projects involved.

Bids were also received during the week for road work by the commission of highways of New York State. As most of the bids that New York has received this year have been satisfactory, it is undoubtedly true that before many days the low bidders named in this week's issue of *Engineering News-Record* will be awarded the contracts. The total mileage involved is 42 and the total low bid on the 42 miles is in excess of $1,250,000.

Oil Company Cuts Wages

Effective Oct. 10 the wages of employees of the Bayonne plant of the Tidewater Oil Company were reduced 18 to 24 per cent. In a statement made public recently by the oil company it was set forth that the reduction was necessary inasmuch as the company had been operating at a loss since Jan. 1, 1921. The scale now effective is comparable to that existing in 1918. Through the resumption of deferred construction work it is hoped that all of the employees, who have been operating on part time, will be given full-time employment.

Unemployed About Four Million

The committee on unemployment statistics of the president's conference on unemployment has found that, owing to the steady improvement which has taken place during the past two months, the survey on unemployment presented to Congress early in August by the Department of Labor should be revised on the basis of later estimates made by that department, the Bureau of the Census and other agencies, to determine the present status of unemployment. The latest statistics available indicate that the number of unemployed at this time, measured in terms of the reduction since January, 1920, in the number of workers on payrolls, exclusive of agriculture, is not less than 3,700,000 or more than 4,000,000.

Pennsylvania To Repair Cars

According to a recent announcement made by President Samuel Rea of the Pennsylvania R.R. that railroad has a plan on foot for the repair of approximately 45,000 idle cars which have been stored without being repaired and none of which is now required for use. However, it is felt that by putting them in order now the road will be prepared for any sharp revival of business in the spring, and also that the general employment situation will be improved.

Unemployment in the Lumber Industry

According to a recent issue of the *National Lumber Bulletin* employment in the lumber industry throughout the United States is approximately 66 per cent of normal. The average is secured from the following individual percentages: California pine mills, 50 per cent; California redwood mills, nearly normal; Pacific Northwest, 62 per cent; Inland Empire, 55 per cent in the saw mills and 40 per cent in the woods; Lake states, 40 per cent; South Atlantic states, 60 to 70 per cent; Gulf states and Arkansas (roughly), 80 per cent; and the central states, 50 to 60 per cent.

Yearly Wage Loss $6,500,000,000

Wage losses to workers in the United States through involuntary idleness have been approximated at $6,500,000,000, in an estimate prepared by the economic experts of the national conference on unemployment. The estimate covers the loss in wages because of unemployment of all the jobless in the country from July, 1920 to August 15, 1921 and was based on an approximation of normal pay levels rather than on the scale at the peak of high wages.

How Construction Has Alleviated Unemployment in Canada

In order that it might have all the supporting data possible upon which to work, there was provided for the sub-committee on construction of the unemployment conference held in Washington last week information concerning public works that had been prosecuted in Canada as a means of mitigating seasonal unemployment. The information contained in this item was supplied to the unemployment conference by the Canadian Employment Service.

Eight out of thirty-six Canadian cities reported a definite policy to lay sewers and water mains during winter months; thirteen others had done so at one time or another to relieve unemployment. The kinds of work which were reported as adaptable to winter construction were sewer work in rock, tunneling, deep excavating, heavy cuts and fills and grading work, concrete construction in large bulk and construction work in swamp and muskeg sections. The degree of the success naturally was dependent upon the preparations made in the fall for continuing the work in severe weather, also upon the character of supervision.

In the comparative cost of doing the work in good and bad weather, in tunneling there was no difference, in rock work less than 25 per cent in excess, and in ordinary sewer construction from 25 to 100 per cent excess. The general conclusion was drawn that winter construction apparently cost about 25 per cent more than construction in milder weather. As these figures apply to Canadian cities, it is natural to assume that the experience would be

less costly in American cities. The additional cost, runs the report, would be offset by certain financial advantages including the fact that contractors would be able to spread their fixed annual overhead over twelve months' operation instead of nine; they would be able to keep their construction gangs together; and they would be able to get better work from men inasmuch as men can work faster in cold weather.

Fabrication of many kinds of material used in public structures can be concentrated in winter months and transported to places where needed. Another suggestion of relieving unemployment was through a concentration rather than the distribution of the purchase of certain government supplies. By concentrating purchases more in the slack season it was pointed out that seasonal fluctuations in private industry might be ironed out in part. In 1913 $1,800,000 of Canadian Government printing and $1,036,000 of Dominion and municipal purchases of textiles were so concentrated. The recommendation was made that this practice be extended as a regular policy.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 6, the next on November 1.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$2.88	$4.00	$4.00	$2.88	$3.16	$4.00	$3.70	$3.75	$4.00
Structural rivets, 100 lb.	3.70	5.25	5.50	3.68	4.15	4.25	5.50	5.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	2.78	3.20	3.50	2.78	3.18	3.57½	2.35	3.75	3.75
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52 6.5–5%	45%	65½%	58 9–5%	38%	51 8%	55%	50%
Cast-iron pipe, 6 in. and over, ton	45.30	40.50	+54.30 44.10	@ 46.10	47.80	52.00	60.00	55.00	—60.00
Concreting Material:									
Cement without bags, bbl.	2.50	2.69	2.55	1.97	2.26	3.10	—2.84	3.10	3.10
Gravel, ¾ in., cu.yd.	2.00	2.13	2.25	1.65	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.25	1.35	2.25	1.65	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.80 to 1.90	2.25	3.20	1.75	2.25	3.50	2.25	—3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	45.00	+38.00	35.00	+48.00	54.00	+50.00	+29.00	+22.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	25.40	+27.50	21.00
Lime common, lump, per bbl.	3.69	1.60	2.75	+1.50	1.40	2.95	—1.90	2.75	15.00
Common brick, delivered, 1,000	+18.90@ 19.40	10.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0765	.124	.0821	—.092	.09	12½	—.10	15
Hollow partition tile 4x12x12, block	.11370	.0765	.124	0.57	.092	.10	14½	—.11	
Linseed oil, raw, 5 bbl. lots, gal.	—.73	.86	—.93	—.81	—.78	—.96	—.83	.79	+.90
Common Labor:									
Common labor, union, hour	.75@ .80	.35		.72½	50	.50@.55	.75	—.50@ .60	
Common labor, non-union, hour		.20	.35@ 45	.35@ .40	50	.35@.40	50@.55	.50—.25@ .30	

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime; white is $1.70 for Kelly Island and $1.65 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Cement price is in Canadian funds, exchange with the United States being 14 per cent at present. Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment.

Changes Since Last Week

Structural steel shapes and plates are quoted at the Pittsburgh mills at $1.60 @ $1.65; with reinforcing bars at $1.60 per 100 lb. Smaller tonnages, however, have been quoted at $1.75 for plates and shapes and $1.65 per 100 lb. for bars. Mill shipments, New York, are quoted at $1.98 @ $2.13 for structural shapes and plates; bars at $1.98 @ $2.03 per 100 lb. Shipments of steel shapes from the mill via all rail to Minneapolis are quoted at $2.51; by lake and rail, $2.45 per 100 lb.

Cast-iron pipe has advanced slightly in Dallas and Chicago and declined in New York and Montreal.

Dallas quotes cement at $2.55 as against $2.80 per bbl.; with sand and gravel both at $2.25 per cu-yd. San Francisco reports a reduction of 5c. per bbl. in cement and Seattle quotes a drop of 50c. per cu.yd. in crushed stone.

Long leaf yellow pine, base sizes, has advanced $3 in Atlanta; $2 in Chicago and $1 per m. ft. in Denver, San Francisco and Seattle.

Hydrated finishing lime is quoted at $27.50 as against $24 per ton, in Seattle. Common lump lime is up 10c. in Chicago and down 35c. per bbl. in San Francisco.

Common brick is quoted at $15.50 @ $16. per 1000, wholesale, in New York. Slight declines in hollow tile are reported in Atlanta and Seattle.

Decreases ranging from 2c. to 8c. per gal. are shown in linseed oil prices in six of the principal cities of the United States; but Montreal quotes an advance of 2c. per gal in 5 bbl. lots.

Common labor is now available in Montreal at 25c. @ 30c. per hr. and labor unions are also reported as being in process of formation there.

In Boston, carpenters are receiving 75c. as against 90c. and common labor 40c. as compared with 55c. per hr., formerly. The wage scale in San Francisco is reported as follows: Brick layers, $1.16; carpenters, hoisting engineers and pile drivers, $1.03; structural iron workers, $1.16; hod carriers, 92c. and common labor, 75c. per hour. Pile-drivers, in New York are receiving $1 as against $1.12½ per hr.; making the present rate $8 as compared with $9 per day, formerly. The State Industrial Commission has approved the building trades' wage reduction schedule in Colorado. Contractors at Colorado Springs, however, have delayed putting the new scale into effect until October 20.